



# The American Journal of Surgery

PUBLISHED MONTHLY BY THE AMERICAN JOURNAL OF SURGERY, INC.

49 WEST 45TH STREET, NEW YORK 19, N. Y.

Editor: THURSTON SCOTT WELTON, M.D., NEW YORK

## EDITORIAL BOARD

FRED H. ALBEE, N.Y.; CARL BECK, Chicago; CLAUDE S. BECK, Clev.; GEO. R. BRIGHTON, N.Y.; MEREDITH F. CAMPBELL, N.Y.; JAMES T. CASE, Chicago; ISIDORE COHN, N.O.; BRADLEY L. COLEY, N.Y.; FREDERICK A. COLLER, Ann Arbor; PAUL C. COLONNA, Phila.; ELLIOTT C. CUTLER, Boston; CHARLES A. ELSBERG, N.Y.; HERBERT C. FETT, Brooklyn; JOHN H. GIBBON, Phila.; EMIL GOETSCH, Brooklyn; CHARLES A. GORDON, Brooklyn; DONALD GUTHRIE, Sayre, Pa.; A. E. HERTZLER, Kansas City; LOUIS J. HIRSCHMAN, Detroit; J. M. HITZROT, N.Y.; FREDERICK C. HOLDEN, N.Y.; EMILE F. HOLMAN, San Francisco; JOHN E. JENNINGS, Brooklyn; W. L. KELLER, Washington; T. J. KIRWIN, N.Y.; ARTHUR KRIDA, N.Y.; A. V. S. LAMBERT, N.Y.; MAURICE LENZ, N.Y.; H. H. LYLE, N.Y.; JEROME M. LYNCH, N.Y.; URBAN MAES, N.O.; HARRISON S. MARTLAND, Newark, N.J.; RUDOLPH MATAS, N.O.; ROY D. McCCLURE, Detroit; H. C. NAFFZIGER, San Francisco; EMIL NOVAK, Balt.; CLARENCE R. O'CROWLEY, Newark, N.J.; LOUIS E. PHANEUF, Boston; EUGENE H. POOL, N.Y.; JAMES T. PRIESTLEY, Rochester, Minn.; DOUGLAS QUICK, N.Y.; N. P. RATHBUN, Brooklyn; HUBERT A. ROYSTER, Raleigh; HENRY S. RUTH, Phila.; M. G. SEELIG, St. Louis; J. BENTLEY SQUIER, N.Y.; H. J. STANDER, N.Y.; GRANT E. WARD, Baltimore; J. H. WOOLSEY, San Francisco.

NEW SERIES, VOLUME LXIII

JANUARY TO MARCH

1944

THE AMERICAN JOURNAL OF SURGERY, INC., PUBLISHERS  
NEW YORK MCMXLIV

COPYRIGHT, 1944  
BY THE AMERICAN JOURNAL OF SURGERY, INC.  
*All Rights Reserved*

*Printed in the United States of America*

## CONTENTS OF NEW SERIES, VOLUME LXIII

### ORIGINAL ARTICLES

Invagination Operation for Esophageal Diverticulum . . . . .	<i>Donald E. Ross</i> . . . . .	3
Recognition and Management of Brain Abscess . . . . .	<i>J. M. Meredith</i> . . . . .	10
Complicated Traumatic Dislocations of the Hip . . . . .	<i>Wellington D. Griesemer</i> . . . . .	16
	<i>{Major A. S. White . . . . .}</i>	
Management of Varicose Veins in Army Personnel . . . . .	<i>{Captain J. J. Haberer . . . . .}</i>	28
	<i>{Major Sam Gendel . . . . .}</i>	
Treatment of Burns. Symposium . . . . .	<i>Hans May</i> . . . . .	34
Skin as a Source of Systemic Infection . . . . .	<i>{I. W. Held . . . . .}</i>	
	<i>{Irving Busch . . . . .}</i>	47
Reduction and After-treatment of Posterior Dislocation of the Elbow. With Special Attention to the Brachialis Muscle and Myositis Ossificans . . . . .	<i>Lyon K. Loomis</i> . . . . .	56
Acute Perforated Duodenal Ulcer . . . . .	<i>Verne G. Burden</i> . . . . .	61
Repair of Urinary Bladder Herniation . . . . .	<i>Alfred H. Jason</i> . . . . .	69
Malignant Tumors of the Stomach . . . . .	<i>Felix de Amesti</i> . . . . .	78
Submuscle Pelvic Tissue Spaces. Anatomy and Clinical Considerations . . . . .	<i>Captain Ben H. Brunkow</i> . . . . .	86
Appendicitis. A Review of 4,283 Cases . . . . .	<i>Moses Bebrend</i> . . . . .	90
Sulfonamides in Fresh and Contaminated Wounds. Mode of Application . . . . .	<i>Comdr. Emile Holman</i> . . . . .	96
Treatment of Skeletal Pain with Procaine Injections. An Analysis of 295 Cases in General Practice . . . . .	<i>Ralph L. Gorrell</i> . . . . .	102
Venography as an Essential Aid in the Treatment of Varicose Veins . . . . .	<i>{Samuel H. Sedwitz . . . . .}</i>	
	<i>{Edgar C. Baker . . . . .}</i>	105
Abdominal Pregnancy—Fifth Month . . . . .	<i>{Louis E. Phaneuf . . . . .}</i>	
	<i>{H. Edward MacMahon . . . . .}</i>	107
Regional Ileitis. Management of Combined Involvement of Distal Ileum and Distal Colon . . . . .	<i>{Major Louis P. River . . . . .}</i>	
	<i>{John W. Howser . . . . .}</i>	
	<i>{Arkell M. Vaughn . . . . .}</i>	118
Subscapular Ossified Hematoma. Case Report . . . . .	<i>{Major J. William White . . . . .}</i>	
	<i>{Major Sydney Hutner . . . . .}</i>	124
Orchitis as a Complication of Brucellosis (Undulant Fever) . . . . .	<i>Earl Sanborn</i> . . . . .	131

## Contents

'enicillin. Case Report of a Patient Who Recovered from Puerperal Sepsis Hemolytic Streptococcus Septicemia . . . . .	<i>{ Robert McN. Mitchell . . . . . Sanford Kaminester . . . . . }</i>	136
Rupture of the Rectosigmoid by Compressed Air. Case Report . . . . .	<i>{ S. A. Swenson, Jr. . . . . Henry N. Harkins . . . . . }</i>	141
Osteochondritis Dissecans. Case Report . . . . .	<i>Theodore B. Strange . . . . .</i>	144
Vesenteric Thrombosis of the Terminal Ileum. Case Report . . . . .	<i>{ William T. Doran . . . . . William T. Doran, Jr. . . . . }</i>	146
New Rhinometer . . . . .	<i>Morton I. Berson . . . . .</i>	148
Surgeon's Thumb Gown . . . . .	<i>A. E. Drexel . . . . .</i>	150
Bone Grafts to the Mandible . . . . .	<i>{ Gordon B. New . . . . . John B. Erich . . . . . }</i>	153
Cesarean Section. The Rational Use of This Operation . . . . .	<i>Denver M. Vickers . . . . .</i>	168
Carcinoma of the Gallbladder. A Clinical and Pathologic Study . . . . .	<i>{ James L. Vadheim . . . . . Howard K. Gray . . . . . Malcom B. Dockerty . . . . . }</i>	173
Management of the External Biliary Fistula . . . . .	<i>R. Russell Best . . . . .</i>	181
Improved Technic for the Closure of a Loop Colostomy . . . . .	<i>John William Howser . . . . .</i>	187
Rapid Rehabilitation in the Shipbuilding Industry . . . . .	<i>Kenneth A. Koerber . . . . .</i>	192
Reconstruction of Nasal Tip. A New Technic. . . . .	<i>Maxwell Maltz . . . . .</i>	203
Pyogenic Liver Abscess in the Aged . . . . .	<i>Captain Robert S. Smith . . . . .</i>	206
Right Inguinal Hernia Following Lower Abdominal Incisions. A Report of Thirty-one Cases . . . . .	<i>Major Norman W. Thiessen . . . . .</i>	214
Rôle of Aseptic Bone Necrosis in Hip Lesions . . . . .	<i>Ernst Bergmann . . . . .</i>	218
Sedation in Patients with Acute Head Injury. . . . .	<i>{ E. S. Gurdjian . . . . . Major J. E. Webster . . . . . }</i>	236
Ceepryn. Clinical and Bacteriological Studies. . . . .	<i>{ G. B. Kramer . . . . . S. H. Sedwitz . . . . . }</i>	240
Persistence of Pain after Appendectomy . . . . .	<i>{ Bernard Judovich . . . . . James Dunn . . . . . }</i>	246
Cardiovascular and Respiratory Effects from Celiac Ganglia Stimulation in Man . . . . .	<i>{ S. J. Martin . . . . . Laurence Miscall . . . . . E. A. Rovenstine . . . . . }</i>	249
Fracture of the Lesser Tuberosity of the Humerus. . . . .	<i>S. L. Haas . . . . .</i>	253
Ectopic Pregnancy. Gestation of Eight Months— Retained Eight Years . . . . .	<i>{ Harry L. Denoon, Jr. . . . . W. Carey Henderson . . . . . }</i>	257
Hernias. Report of Two Unusual Cases . . . . .	<i>{ Captain Milton N. Camp . . . . . Major Sherman E. Andrews . . . . . }</i>	259

## Contents

v

Permanent Urinary Continence Following Pelvic Surgery . . . . .	<i>Commander Phineas Bernstein</i>	261
Right Traumatic Diaphragmatic Hernia . . . . .	<i>John Roberts Phillips</i>	267
Postpartum Hematomas. Report of Four Cases . . . . .	{ <i>Samuel Lubin</i> . . . . . <i>Irving Horowitz</i> . . . . .}	272
Subastragaloid Dislocation. Report of an Unusual Ski Injury . . . . .	{ <i>Major Merle J. Brown</i> . . . . . <i>Captain Walter E. Brown, Jr.</i> . . . . .}	276
Modified Overhead Support for Postoperative Use . . . . .	{ <i>Walter G. Goehring</i> . . . . . <i>W. Orr Goehring</i> . . . . .}	278
Simple Apparatus for the Care of an Ileostomy . . . . .	<i>John H. Grindlay</i> . . . . .	280
American Pioneers in Abdominal Surgery. . . . .	<i>Bernard J. Ficarra</i> . . . . .	282
Cancer of the Lip. A Study of Fifty-six Five-year Cases . . . . .	<i>C. A. Whitcomb</i> . . . . .	304
Diagnostic Value of Blood Studies in Malignancy of the Gastrointestinal Tract. . . . .	<i>H. Leonard Bolen</i> . . . . .	316
Modified Non-adherent Gauze Pressure Treatment for Burns. . . . .	{ <i>Wallace Marshall</i> . . . . . <i>Elena Greenfield</i> . . . . .}	324
Combination of Nail and Screw for the Fixation of Fractures of the Neck of the Femur . . . . .	<i>Herbert A. Johnston</i> . . . . .	329
Parenteral Fluid Administration beneath the Fascia Lata. . . . .	{ <i>Robert Kent Finley</i> . . . . . <i>James Milo Shaffer</i> . . . . . <i>Alfons Altenberg</i> . . . . .}	337
Perineorrhaphy Postpartum versus Perineal Repair. Original Technic. . . . .	<i>Louis Drosin</i> . . . . .	344
Spinal Anesthesia and the Severely Wounded. . . . .	<i>Leonid Watter</i> . . . . .	348
Fracture of Tibia and Fibula Treated by T and G Bone Plate. . . . .	{ <i>Comdr. R. D. Joldersma</i> . . . . . <i>Comdr. F. L. Macpherson</i> . . . . .}	352
Operation for Pilonidal Sinuses. . . . .	<i>Major Roland W. Hipsley</i> . . . . .	357
Retroperitoneal Mucocele of the Appendix. Case Report . . . . .	{ <i>William H. Myers</i> . . . . . <i>Ruth F. Rominger</i> . . . . .}	362
Lateral Osteotomy. Anatomical Considerations . . . . .	<i>Conrad K. Gale</i> . . . . .	368
Cotton Suture Material. Importance of Surgical Principles . . . . .	{ <i>Lieut. Colonel Buford Word</i> . . . . . <i>Captain Clayton E. Brock</i> . . . . .}	371
Pain in the Shoulder and Upper Extremity Due to Scalenus Anticus Syndrome . . . . .	{ <i>Bernard Judorich</i> . . . . . <i>William Bates</i> . . . . . <i>William Drayton, Jr.</i> . . . . .}	377
Primary Adenocarcinoma of the Jejunum with Intussusception. Case Report. . . . .	{ <i>John B. O'Donoghue</i> . . . . . <i>Manuel E. Lichtenstein</i> . . . . . <i>Maurice B. Jacobs</i> . . . . .}	382

Bilateral Renal Lithiasis. Case Report . . . . .	Elmer Hess . . . . .	388
Acute Hemorrhagic Pancreatitis. A New Etiological Concept and Case Report . . . . .	{Nathan N. Brodie . . . . . }Bernard J. Ficarra . . . . .	394
Polyposis of the Gallbladder. Report of a Case Diagnosed Preoperatively by Roentgenologic Examination . . . . .	{J. Gregory Grego . . . . . }Henry N. Harkins . . . . .	398
Abdominal Pregnancy. Case Report . . . . .	Samuel A. Dibbins . . . . .	402
Congenital Teratoma of the Thyroid. Case Report . . . . .	{Paul W. Sutton . . . . . }Edward W. Gibbs . . . . .	405
Inversion of Uterus. Report of Two Cases and a New Method of Hemorrhage Control . . . . .	Walter A. Norton . . . . .	408
Absence of Half of the Left Diaphragm. Case Report . . . . .	{Millard S. Rosenblatt . . . . . }J. B. Bilderback . . . . .	411
Esophageal Varices. Case Report . . . . .	{Bernard Welt . . . . . }Simon R. Blatteis . . . . .	415
Treatment of Fracture of Astragalus by Internal Fixation with Metal Pin. Case Report . . . . .	Darid O. Weiner . . . . .	418
Evolution of Bone Graft Surgery . . . . .	Fred H. Albee . . . . .	421

# The American Journal of Surgery

Copyright, 1944 by The American Journal of Surgery, Inc.

A PRACTICAL JOURNAL BUILT ON MERIT

Fifty-third Year of Continuous Publication

NEW SERIES VOL. LXIII

JANUARY, 1944

NUMBER ONE

## Editorial

### AN ASCITIC FLUID BANK

FOLLOWING reports of the use of ascitic fluid as a substitute for whole blood we determined early in 1940 to inaugurate an ascitic fluid bank as a majority of our patients as well as donors available were markedly anemic with hemoglobin averages of 45 to 60 per cent (Salhi) and a constant supply of ascitic fluid was always available from cirrhosis cases in the hospital. Davis and White had found ascitic fluid contained a total protein of 2.0 to 3.19 Gm. per 100 cc. of ascitic fluid; albumin values ranged from 0.96 to 1.9 Gm. per 100 cc. with globulin of 0.6 to 0.8 Gm. per 100 cc. of ascitic fluid. The non-protein nitrogen was reported as 18 to 40 mg. with sodium chloride values of 700 to 750 mg. and calcium of 6.8 to 7.8 mg. We conducted similar studies which disclosed approximately the same values with protein values as high as 4.2 Gm. per 100 cc. of fluid. Davis and White and Choisser and Ramsey reported that ascitic fluid was efficacious in maintaining the systolic blood pressure in dogs in mild and moderately severe shock. No albuminuria, glycosuria or hematuria following its use was noted. Infarction in the brain and lung with death was noted in dogs by Choisser and Ramsey with the use of incompatible fluid and both groups of observers felt cross-matching was

necessary because of agglutinins present. We soon observed considerable clotting of fibrin took place in ascitic fluid and believed that infarcts in these cases might be due to fibrin emboli.

The usual Kahn, cultures and, for a time, cross-matching was done on all ascitic fluid used. Repeated filtration or the addition of 50 cc. of 5 per cent sodium citrate per 1,000 cc. of ascitic fluid is necessary to prevent fibrin clots acting as emboli. The transfusing of incompatible ascitic fluid diluted with equal parts of saline without reaction and Wiener's statement that absorption of the donor's agglutinins by tissue cells of the recipient and neutralization by the recipient's own serum will tend to prevent reactions in plasma transfusions led us to use unmatched, undiluted ascitic fluid in a majority of our transfusions. It can be stated it is not necessary to match ascitic fluid as pooled ascitic fluid agglutination titer is low due to neutralization of various iso-agglutinins from different donors. The serum of the recipient has the power of neutralizing agglutinins and the body tissue cells have the property of also neutralizing agglutinins when the titer is low as it is in pooled ascitic fluid. Hemolytic reactions would not be anticipated in ascitic fluid transfusions as Wiener has pointed out the antigens involved in fatal hemolytic reactions are in the red blood cells and not in

\* Work done at The Miraj Medical Center, Miraj, India.

the plasma. In over 300 ascitic fluid transfusions in humans we have not noted evidence of hemolytic reactions.

It has been stated that it was not known whether retransfusion after an incubation period of three to five weeks would produce shock in using ascitic fluid. We determined to test this in a series of patients of which thirty were successfully followed. Twenty patients were given intradermal tests with pooled ascitic fluid and transfusions of 300 cc. of pooled ascitic fluid. After a varying period of three to six weeks they were again intradermally tested and again given transfusions of 200 cc. of the same pooled ascitic fluid. The fluid each time was given cold and by the drip method. None of these patients had reactions or showed any evidence of sensitivity such as urticaria, asthma or diarrhea nor was any renal irritation noted. Ten other patients were given transfusions in an identical manner using ascitic fluid removed from the same patient at the time of the original transfusion. No sensitivity was noted; in one patient a chill and slight albuminuria was noted but this was no more severe than was noted at times with glucose. Zimmerman, Strauss and Laufman have recently pointed out that allergic reactions may occur in transfusions of blood of patients with a history of allergy; the same is probably true of ascitic fluid.

In our experience with an ascitic fluid bank we have seen several cases of ascites in which the ascitic fluid was bloody. It should be emphasized that such fluid is not acceptable for an ascitic fluid bank as hemolysis of cells may have already taken place. In addition all of the donors of such fluid we have seen have either had malignancies or marked lowering of the prothrombin time or both; they have failed to respond to adequate amounts of vitamin K.

In over 300 ascitic fluid transfusions from an ascitic fluid bank we have found ascitic fluid is a fairly satisfactory substitute for blood or plasma in the treatment and prevention of shock. Approximately twice as much ascitic fluid is used in a case as would be used if whole blood were being used.

It is not necessary to cross match ascitic fluid as the agglutination titer in pooled ascitic fluid is low and these agglutinins are sufficiently neutralized by the serum and body cells of the recipient to prevent reactions.

Bloody ascitic fluid should not be used in an ascitic fluid bank. The donor should be suspected of either malignancy or prothrombin deficiency or both. In our experience these donors have failed to respond to adequate amounts of vitamin K.

RICHARD E. STRAIN, M.D.



# Original Articles

## INVAGINATION OPERATION FOR ESOPHAGEAL DIVERTICULUM

DONALD E. ROSS, M.D.

Surgical Staff of the Ross-Loos Medical Group  
LOS ANGELES, CALIFORNIA

THE invagination method of operation is not new. Girard<sup>1</sup> used it extensively in France. Others in this country have tried it. Why it has not become popular and in general use is difficult to understand. The time honored method of extirpation in one or two stages carries with it the danger of leakage and infection even in the best of hands. If the facts were known, the vast majority of surgeons experience more difficulty from these complications than the published reports would lead us to believe. The invagination method carries with it much less danger as the sac is not opened. If the closing stitches are placed carefully and include only muscle layers, there should never be any leakage. The operation seems much more applicable for use by our vast group of surgeons. It is also very rare that it may not be used. Even large sacs become small ones when the overlying fascia is removed.

*History of Early Operations.* Nicola-doni, who was the first to operate on a diverticulum in Vienna in 1877, created a fistulous opening. Wheeler, in 1886, performed the first successful removal. Stetten, in 1910, reported forty-eight cases with a mortality rate of 18.7 per cent. It is believed that infection was primarily responsible for this high rate.

*Embryology and Pathology.* (1) the Pul-sion type are more properly called pharyngeal diverticula since they herniate through strands of pharyngeal muscle. (2) Traction diverticula occur in the mid-thorax and

usually empty well, as the orifice is at a more dependent position than the sac. (3) Esophageal diverticula also occur at the lower end of the esophagus. This type will not come within the scope of this paper.

*Etiology.* Moersch and Judd<sup>3</sup> stated that goiter might have an influence. In our three cases one patient had a previous thyroidectomy and a second patient had a large substernal goiter as a complication.

Jackson<sup>2</sup> believed there was an inco-ordination in the neuromuscular mechanism which results in failure of the lower part of the constrictor muscle to open when a bolus of food arrives at this point. This momentarily causes a great increase in pressure. Some patients give a history of some difficulty in swallowing since early childhood.

Mosher<sup>4</sup> believes there is an embryological background since similar pouches are present normally in some animals, notably the pig. Here there are two pouches, an upper and a lower, but only the lower persists. It may be noted that there may normally be an asymmetry in the pharynx, the pyriform fossa, for example, may be absent. This theoretically might put swallowing reflex off center resulting in strain.

*Pathology.* In the case of pharyngoesophageal type of diverticulum the sac consists chiefly of mucous membrane covered by areolar tissue which has herniated out between the muscular fibers. Small blood vessels may extend onto the sac. The diverticulum makes its exit posteriorly

but nearly always extends out toward the left side and downward along the esophagus. As a rule the sac does not create a

the operation. As a rule this distends the sac readily as a rubber bag would when filled with a heavy fluid. When the sac is

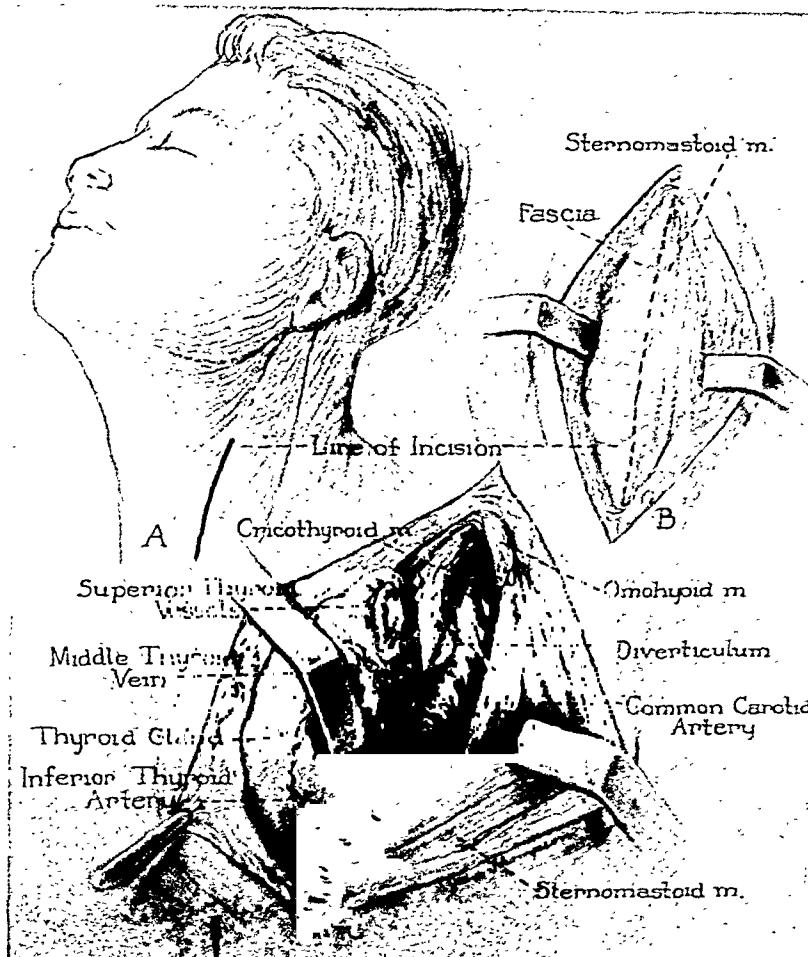


FIG. 1. A, this illustrates the position of the incision. B, shows the line of incision of the fascia. C, shows the thyroid with its vascular connections divided and retracted, bringing the diverticulum into view at a deeper level.

swelling which is visible in the neck but may do so. Also it may be seen on the right side, but even then it is best approached from the left.

In some instances it may be bound to the esophagus or to the thyroid lobe by loose areolar tissue. It is stated that there is difficulty in knowing exactly where the sac begins and where the dissection between esophagus and the sac should be made. This is not true in my experience, the sac being fairly easy to distinguish. A very good way to facilitate this is to have the patient swallow some water at the time of

emptied by pressure, it contracts to only a fraction of its size, showing a marked degree of elasticity. As a rule there is a slight deviation of the esophagus at the neck of the sac so that when food is swallowed it seems to drop into the sac more readily than it does into the esophagus. There may also be a stricture or considerable narrowing of the esophagus at this particular point. Some authors have, therefore, suggested the patient's swallowing a thread along which a stomach tube is threaded. This more definitely outlines this area at the time of operation.

After the muscle fibers have been peeled off the base and the small blood vessels caught and tied, the sac, being of an elastic nature, has a tendency to contract. This property of the sac explains its contraction after it has been invaginated into the lumen of the pharynx. It shrinks readily and causes no trouble or harm and does not act as a foreign body.

*Symptoms and Signs.* Typical symptoms are dysphagia, regurgitation of food, an irritable cough, hoarseness sometimes, and in many cases, particularly in old men, there is loss of weight. A large amount of salivation is also present in most cases.

Often food remains in the sac and putrefies, causing a foul odor to the breath; this complaint alone may bring the patient to the doctor. The food seems to drop into the sac first and if this is large, it may twist the upper end of the esophagus so that swallowing is difficult. It may take a long time for the patient to swallow his meal and inanition may result.

*Diagnosis.* The most important method of diagnosis is by x-ray, having the patient stand while some barium solution is being swallowed. Thus the filling of the sac can readily be seen. It is advisable to follow the descent of the barium into the stomach and be sure there are not other diverticula or disorders lower down.

Esophagoscopy is of some value but this, as a rule, yields less information than does the x-ray picture. Sometimes a lump is felt in the neck to the left of the esophagus, but this is unusual. Where a stricture is suspected, the extent of this must be investigated and estimated.

*Indications for Operation.* The chronic irritation and coughing which produces restlessness, loss of sleep and loss of weight are the chief indications for surgery.

#### OPERATIONS

*The Usual One-stage Operation.* The danger of operation is chiefly that of infection in the deep fascial planes of the neck. It may be recalled that these fascial planes

run down into the mediastinum without any anatomical barrier, and if there is leakage from the operative site there may

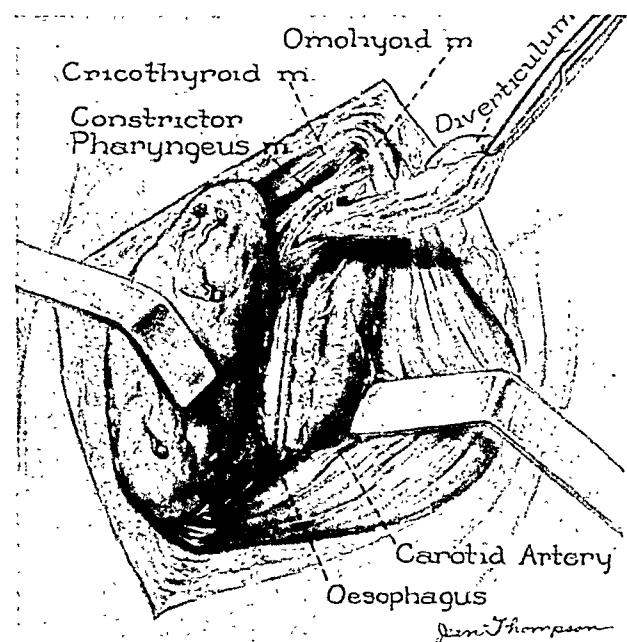


FIG. 2. This illustrates the further dissection of the diverticulum.  
John Thompson

be widespread infection which may travel downward along these planes and cause generalized infection in the mediastinum with death to the patient.

*The Two-stage Operation.* For the surgeon who operates these cases only occasionally it is much safer to use the two-stage operation. The first procedure in this type of operation is to free the sac and elevate it so that it drains by gravity, packing around the sac with gauze to stimulate the formation of adhesions in the fascial planes of the neck. Occasionally, this is all that is necessary. The sac in these cases collapses and remains empty, causing no symptoms. In most cases, however, it is advisable to operate again, free the sac and cut it off and suture the base or neck of the sac, and in addition repair the muscular coat over the hernial orifice.

*Operation by Invagination (Recommended by the author).* Anesthesia is accomplished by blocking off the skin with 1 per cent novacaine and deep injection along the posterior border of the sternomastoid muscle.

An incision about four inches in length is made along the medial border of the sternomastoid muscle from the sternal notch upward and outward. The dissection then is carried between the sternomastoid and the infrathyroid group of muscles and these are retracted exposing the lateral border of the thyroid gland. The middle thyroid vein and the inferior thyroid artery are ligated and divided. This permits retraction medially of the thyroid gland and the carotid artery is retracted laterally. This exposes the esophagus. The sac of the diverticulum is then seen running down along the esophagus. The author has

not experienced any difficulty in locating this and bringing it up out of its bed with blunt dissection. The sac is seen to be

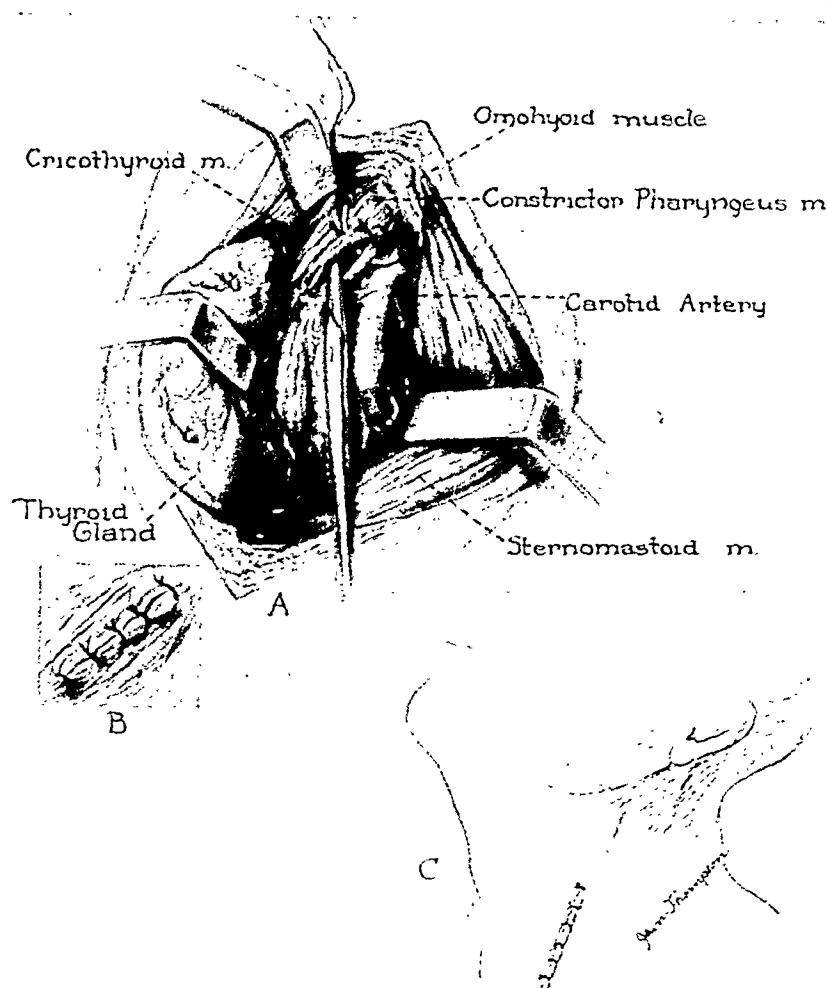


FIG. 3. A, the esophageal diverticulum has now been invaginated and is held in this position by the hemostat. The break in the pharyngeal muscle is shown being repaired by interrupted sutures of silk. B, illustrates the wound closure. C, illustrates the wound closure.

notch upward and outward. The dissection then is carried between the sternomastoid and the infrahyoid group of muscles and these are retracted exposing the lateral border of the thyroid gland. The middle thyroid vein and the inferior thyroid artery are ligated and divided. This permits retraction medially of the thyroid gland and the carotid artery is retracted laterally. This exposes the esophagus. The sac of the diverticulum is then seen running down along the esophagus. The author has

covered with a thin layer of fascia which is stripped off with gauze dissection. A few small blood vessels run up into the neck of the sac. These are ligated and divided. The neck of the sac is cleaned with gauze to outline the muscle edges. These are seen to be quite clear cut. The sac which has now contracted down to a mere fraction of its former size is invaginated into the pharynx and held there while the opening in the muscle is closed with interrupted sutures of silk. These are reinforced

42,400 Oxford units were given during the first twenty-four hours. This dosage was repeated on the second day. On the third day 5 per cent glucose in alternate solutions of distilled water and normal saline. The remainder of the twenty-four hours penicillin was administered either intramuscularly or subcutaneously.

Date	Day Post-Op	Red Blood Cells, Millions	White Blood Cells, Millions	Poly., Per Cent	Lymph., Per Cent	Mon., Per Cent	Neut., Per Cent	18 M.M.	Blood Culture	S.d.	Blood Transfusions
Differentiation											
4-30-43	21	2.31	29,300	8.3	98	14	20 min.	...	...	...	...
5-1-43	22	2.31	29,300	8.3	98	14	20 min.	...	...	...	...
5-2-43	23	2.31	29,300	8.3	98	14	20 min.	...	...	...	...
5-3-43	24	2.31	29,300	8.3	98	14	20 min.	...	...	...	...
5-4-43	25	2.31	29,300	8.3	98	14	20 min.	...	...	...	...
5-5-43	26	2.31	29,300	8.3	98	14	20 min.	...	...	...	...
5-6-43	27	2.31	29,300	8.3	98	14	20 min.	...	...	...	...
5-7-43	28	2.31	29,300	8.3	98	14	20 min.	...	...	...	...
5-8-43	29	2.31	29,300	8.3	98	14	20 min.	...	...	...	...
5-9-43	30	2.31	29,300	8.3	98	14	20 min.	...	...	...	...
5-10-43	31	2.31	29,300	8.3	98	14	20 min.	...	...	...	...
5-11-43	32	2.31	29,300	8.3	98	14	20 min.	...	...	...	...
5-12-43	33	2.31	29,300	8.3	98	14	20 min.	...	...	...	...
5-13-43	34	2.31	29,300	8.3	98	14	20 min.	...	...	...	...
5-14-43	35	2.31	29,300	8.3	98	14	20 min.	...	...	...	...
5-15-43	36	2.31	29,300	8.3	98	14	20 min.	...	...	...	...
5-16-43	37	2.31	29,300	8.3	98	14	20 min.	...	...	...	...
5-17-43	38	2.31	4,500	8.3	98	14	20 min.	...	...	...	...
5-18-43	39	2.31	4,500	8.3	98	14	20 min.	...	...	...	...
5-19-43	40	2.31	4,500	8.3	98	14	20 min.	...	...	...	...
5-20-43	41	2.31	4,500	8.3	98	14	20 min.	...	...	...	...
5-21-43	42	2.31	4,500	8.3	98	14	20 min.	...	...	...	...
5-22-43	43	2.31	4,500	8.3	98	14	20 min.	...	...	...	...
5-23-43	44	2.31	4,500	8.3	98	14	20 min.	...	...	...	...
5-24-43	45	2.31	4,500	8.3	98	14	20 min.	...	...	...	...
5-25-43	46	2.62	4,200	7.5	63	21	2	positive	250 c.c.	...	...
5-26-43	47	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-27-43	48	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-28-43	49	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-29-43	50	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-30-43	51	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-31-43	52	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-32-43	53	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-33-43	54	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-34-43	55	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-35-43	56	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-36-43	57	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-37-43	58	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-38-43	59	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-39-43	60	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-40-43	61	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-41-43	62	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-42-43	63	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-43-43	64	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-44-43	65	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-45-43	66	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-46-43	67	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-47-43	68	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-48-43	69	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-49-43	70	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-50-43	71	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-51-43	72	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-52-43	73	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-53-43	74	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-54-43	75	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-55-43	76	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-56-43	77	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-57-43	78	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-58-43	79	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-59-43	80	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-60-43	81	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-61-43	82	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-62-43	83	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-63-43	84	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-64-43	85	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-65-43	86	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-66-43	87	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-67-43	88	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-68-43	89	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-69-43	90	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-70-43	91	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-71-43	92	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-72-43	93	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-73-43	94	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-74-43	95	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-75-43	96	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-76-43	97	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-77-43	98	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-78-43	99	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-79-43	100	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-80-43	101	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-81-43	102	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-82-43	103	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-83-43	104	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-84-43	105	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-85-43	106	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-86-43	107	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-87-43	108	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-88-43	109	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-89-43	110	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-90-43	111	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-91-43	112	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-92-43	113	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-93-43	114	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-94-43	115	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-95-43	116	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-96-43	117	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-97-43	118	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-98-43	119	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-99-43	120	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-100-43	121	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-101-43	122	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-102-43	123	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-103-43	124	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-104-43	125	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-105-43	126	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-106-43	127	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-107-43	128	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-108-43	129	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-109-43	130	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-110-43	131	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-111-43	132	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-112-43	133	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-113-43	134	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-114-43	135	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-115-43	136	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-116-43	137	2.62	3,800	7.5	63	21	2	positive	250 c.c.	...	...
5-117-43											

stata was brigthened, urinary and fecal incontri-  
mence became controlled, and pulse and respira-  
tion improved. The temperature was normal  
in forty-eight hours. Together with these

338,300 Oxford units of penicillin were given over the course of eleven days. Within twenty-four hours following the inauguration of this therapeutic bombing shell

TABLE II (Continued)

cumincously in gradually decreasing amounts, the patient's condition was decidedly improved. The fever began to subside, the mental

diverticulum was dealt with. The sac was at least two and one-half inches in diameter. When the overlying fascia was removed, the sac was seen to be thin and elastic and contracted down to about the size of a grape. Invagination was done, and the orifice sutured with interrupted silk. A nasal tube was passed down into the stomach and was left in place for forty-eight hours. Convalescence was rapid and the patient was dismissed from the hospital in five days.

He has had complete relief of symptoms. Direct examination through the mouth showed at first only a little fold of edematous mucous membrane and a later examination revealed a normal appearance.

**CASE III.** A male, age forty-seven, was operated upon September 30, 1942. His chief complaint was difficulty in swallowing. The patient had to take a long time with his meal and was annoyed by the spilling over of the contents of the sac. No lump could be palpated in the neck, but the sac showed plainly when barium was taken and the fluoroscope was used.

At operation the sac was nearly two inches in diameter and seemed rather pharyngeal than esophageal. In other words, it arose at a slightly higher level than our other cases and the wall was slightly thicker. However, invagination of the sac and suture of the hiatus in the constrictor was done.

The patient made an uninterrupted recovery and left the hospital in five days. This patient complained somewhat of difficulty in swallowing for a few days, but this rapidly improved and two weeks postoperatively all symptoms had disappeared. Again direct visualization showed that the invaginated sac had con-

tracted so that only a small redundant fold remained. It is believed that it will contract still farther.

#### SUMMARY

1. The author has attempted to review briefly the salient features of esophageal diverticula.
2. Case reports are hereby given illustrating a method for inversion of the sac and repair of the orifice.
3. This operation is recommended by the author because: (1) It allows the patient to be operated on at one stage; (2) the sac is not opened so that the danger of infection is minimized; (3) the natural contractile character of the sac causes it to shrink and causes no trouble by its presence in the pharynx; (4) it adds another method of operating which may be used to advantage in selected cases, and (5) our patients have had very satisfactory results and continue to enjoy perfect health. The author, therefore, recommends this procedure.

#### REFERENCES

1. GIRARD, C. Du traitement des diverticules de l'oesophage. *Assoc. Franç. de chir. Proc. verb.*, 10: 392-407, 1896.
2. JACKSON, C. L. and C. Pulsion diverticulum of esophagus and hypopharynx. *South. Surgeon*, 2: 255-266, 1933.
3. MOERSCH, H. J. and JUDD, E. S. Diagnosis and treatment of pharyngo-oesophageal diverticulum. *Surg., Gynec. & Obst.*, 58: 781-785, 1934.
4. MOSHER, H. P. The esophagus. *Surg., Gynec. & Obst.*, 60: 403-417, 1935.
5. MCCLURE, R. D. Pharyngeal or pharyngo-esophageal diverticulum; new operation: inversion and snare. *Am. J. Surg.*, 24: 732-745, 1934.



# RECOGNITION AND MANAGEMENT OF BRAIN ABSCESS\*

J. M. MEREDITH, M.D.

Associate Professor of Neurological Surgery, Medical College of Virginia  
RICHMOND, VIRGINIA

SEVERAL classifications of brain abscess have, from time to time, appeared in medical literature. A useful one relates to etiology: (1) Secondary to nasal or paranasal sinus disease; (2) secondary to ear and mastoid disease; (3) subsequent to compound wounds of the head, particularly when the dura has been lacerated; (4) "metastatic" brain abscess from suppurative processes elsewhere in the body, such as: chronic osteomyelitis of the long bones, lung abscess, bronchiectasis, etc. Undoubtedly, the first two etiological factors are by far the most important from the standpoint of frequency and as sources of the more surgically favorable abscesses.

A brain abscess may be located in the cerebrum, the cerebellum or the brain stem. This paper concerns itself only with those in the cerebrum and cerebellum proper and does not include the extradural and subdural abscesses which are not *true* abscesses in the surgical definition of the term, i.e., an infection which is circumscribed or walled-off and surrounded by a more or less well defined capsule.

## HISTORY

The history in a case of brain abscess is often of the greatest importance, but, occasionally, a record of previous infection is not given the weight it should have in the differential diagnosis because at the time the patient first comes under observation a previous infection may be quiescent or seemingly "cured." One such case, seen several years ago at the University of Virginia Hospital in Charlottesville, was that of a white boy of ten years who had had a right-sided otitis media without a

mastoid operation three months before admission to the hospital. Paracentesis of the right ear drum had been done and one of the sulfonamides had been administered. The ear infection subsided; the temperature became normal, and the boy appeared well until about two weeks before his hospital admission when drowsiness supervened together with headache and vomiting. There was no drainage from either ear at that time. The child had a marked ataxia of the extremities on the right side and a high degree of choked disk bilaterally. The temperature was subnormal, and the pulse rate was 50 to 60 per minute. A cerebellar tumor was presumed to be more likely than abscess, and a bilateral cerebellar exploration was carried out after a ventriculogram had disclosed an internal hydrocephalus of marked degree. A large abscess was encountered and drained in the right cerebellar hemisphere near the cortex, marsupialization being carried out. The child eventually recovered after a prolonged convalescence due to a persistent cerebrospinal fluid fistula which finally could be closed.

A history of head trauma and of ear and sinus infections (frequently mild) is often obtained in cases of brain tumor (demonstrated at operation) and proves to be of no clinical importance. Relatives and friends of the patient often prefer to believe that such an inciting factor (particularly trauma) is the real cause of the symptoms. On the other hand, a history of a fairly recent head injury, especially one involving the paranasal sinuses or the mastoid, should be given careful consideration when the diagnosis is considered in a patient with

\* From the Department of Neurosurgery, Medical College of Virginia, Richmond, Dr. C. C. Coleman, Director. Read before the Richmond E. E. N. & T. Society, October 19, 1942, and the Monthly Staff Meeting of the Retreat for the Sick Hospital, February 15, 1943, Richmond, Virginia.

increased intracranial pressure with reference to the possible presence of a brain abscess. Months may elapse after such an injury before signs of increased intracranial pressure develop due to a brain abscess. It is most important, *surgically*, to suspect an abscess preoperatively, when it is present, as such a lesion, in contrast to intracranial tumors, is usually dealt with through a small burr opening rather than an osteoplastic flap or suboccipital craniectomy, to prevent spread of infectious material over the cortex of the brain and into the subarachnoid space.

All compound depressed skull fractures in which the dura and the brain cortex have been lacerated are potential cases of brain abscess postoperatively, even in this day of early operations after head injury and the use of sulfonamides. If signs of increased intracranial pressure develop weeks or months after an operative repair of a compound skull fracture with dural laceration, an abscess must be considered. Such a complication is, however, a remarkably infrequent occurrence in such cases, provided the primary operation has been properly performed a few hours after trauma.

In regard to a "metastatic" abscess from distant foci in the body, every patient who has had a boil or carbuncle, chronic osteomyelitis of the long bones, a lung abscess or bronchiectasis is a possible candidate for a brain abscess, just as a *spinal* extradural abscess may develop from the same sources.

#### PATHOLOGICAL ANATOMY—PATHOGENESIS

Concerning the paths of infection into the meninges from the nose and ear, Eagleton,<sup>1</sup> in an extensive review of the subject, quotes Rosenow's<sup>2</sup> careful experimental work which demonstrates that trauma, operative or otherwise, produced in a patient who is the host of a quiescent infectious lesion, such as a nasal sinus or mild chronic ear infection, can institute a bloodstream invasion, which, if the microorganism has a selective action on the

central nervous system, may cause a grave infection. From the nose, infection can travel to the frontal lobe by way of the arachnoid prolongations surrounding the olfactory nerve. Developmentally, there is no evidence, according to Weed and Sabine,<sup>3</sup> that the lymphatics extend into the central nervous system, but the arachnoid prolongations along the olfactory nerve have a communication in the mucous membranes of the nose with the lymphatic system. Sphenoid disease can involve the supra-adjacent basilar cisternae through the periosteum and bony wall of the sphenoid sinus.

Infection in the nose and ear can also be transmitted to the brain by venous extension. It has been demonstrated that the venous circulation of the tympanic cavity is in direct communication with the inferior petrosal sinus, independent of the internal auditory veins; and there also exist direct venous relations between the tympanic cavity and the apex of the petrous portion of the temporal bone. In sphenoid and other sinus diseases, osteomyelitis of the sinus wall and adjacent skull can occur from a primary infection of the mucous membrane of the sinus, thence along the Haversian spaces to the diploë of the osseous wall of the sinus and, occasionally, to the cavernous and other venous sinuses.

Bloodstream infection and transmission is undoubtedly the mechanism for the production of brain abscess from a distant focus as in osteomyelitis of the long bones, etc., and direct inoculation infection is the mode of entry in brain abscesses following compound head wounds, especially in those in which the dura and the cerebral cortex have been lacerated at the time of trauma.

It is the ability or failure of the host to form a capsule about the more or less localized brain infection that makes for success or failure, in large measure, in the operative attack upon any individual case of brain abscess. Otogenic brain abscesses resulting from otitis media and mastoiditis

are in the majority, and extension from these sources, most frequently, involves the temporosphenoidal lobe (cerebrum) and the cerebellum. In one series of cases quoted by King,<sup>4</sup> 83.2 per cent of a series of brain abscesses arose primarily from an otitis media and mastoiditis, and 9.1 per cent from infections of the nasal cavity and its accessory sinuses. The spread of infection to the brain from the middle ear and from mastoiditis, by direct extension, is through purulent thrombosis of the lateral sinus, osteomyelitis of the tympanic wall, along the adventitial spaces of perforating blood vessels, and through the internal auditory meatus. The spread of infection from the nasal cavity and its accessory sinuses, by direct extension, is due to osteomyelitis of the sinus wall, along the perineural spaces, and along and through the veins.

Another rarer source of brain and subdural abscess is in the patient with a skin malignancy of the scalp, of, perhaps, many years' duration, that fails to heal entirely in spite of surgical excision and x-ray or radium therapy. Signs of infection (chills, high fever, etc.) and/or increased intracranial pressure and, occasionally, convulsions herald the invasion of the meninges and/or the brain itself from the original external infection.

Regardless of the mode of infection, a brain abscess commences with an inflammatory leucocytic infiltration and actual softening of the subcortical brain substance and terminates by the conversion of a portion of the brain into a cavity containing pus. In the acute form the abscess has no definite wall. It consists of a broken down area of brain tissue, which might be termed acute suppurative encephalitis, with a central area containing pus and necrotic material from degeneration of the subcortical white matter. The wall, at first, is irregular and ill-defined and consists of brain tissue with a shaggy surface, surrounded by an area of edematous brain substance. Should the patient be fortunate, this process becomes chronic

in that a well defined wall or capsule is established, and the abscess then truly follows the old surgical description of an abscess as being a "circumscribed cavity containing pus." The wall of the abscess consists of an internal layer composed of purulent tissue, the so-called "pyogenic membrane," and an external layer of granulation tissue composed of various proportions of fibrous macroglia and fibrous tissue derived from the vascular adventitia and, in some instances, from the leptomeninges. The granulation tissue is infiltrated with plasma cells, lymphocytes, and a few eosinophiles. The infiltration is continued in the adventitia of the vessels for a considerable distance into the brain.

It has not been determined accurately how long it takes for a definite wall or capsule to form around a brain abscess. Penfield<sup>5</sup> stated that the wall of an abscess begins to form in the first week after invasion of the brain, but that it does not offer resistance to a brain cannula until two to three weeks have elapsed.

Grant<sup>6</sup> has noted that a definite capsule or firm wall is well established in the interval between the fourth and sixth weeks after invasion of the brain, and Bagley<sup>7</sup> has shown a section of an abscess wall which formed in three or four weeks. Bagley has stated that the thickness and firmness of the abscess wall will be determined by the relative amount of mesoblastic and glioblastic fibrous tissue present, the amount of glial tissue in the wall, and the length of time the abscess has existed. If not evacuated in time, the abscess tends to rupture into the subarachnoid space or into an adjoining ventricle with disastrous results (meningitis or purulent ependymitis).

#### SIGNS AND SYMPTOMS—DIAGNOSIS

The state of consciousness is, perhaps, the most important single observation which the physician can make in a suspected case of brain abscess. If the patient is conscious, well oriented, and alert, no matter how high the fever (frequently in

favorable cases there is little or no pyrexia) or how slow the pulse, an abscess requiring immediate drainage is unlikely, although possible. A choked disk in one or both eyes, sometimes of a high degree, is almost the rule in *favorable* cases of brain abscess; a homolateral third nerve paralysis is frequent in frontal lobe abscess. On the other hand, abscess of the brain is notoriously treacherous and difficult to diagnose and, more than once, to the chagrin of the clinician, the pathologist has revealed, at the postmortem table, a large "silent" brain abscess (perhaps with rupture into the ventricular system) as the cause of the patient's death. The reason for this is that once infection has entered the cerebral substance, it finds itself in tissue lacking lymphatics, so that if the meninges have protected themselves against it, if it is associated with an infected sinus draining externally, or if it does not break into a lateral ventricle, it fails to cause the ordinary signs of infection. Should an abscess form in the temporal or frontal lobes, the most common sites, or in the cerebellum and not, at first, be extensive enough to cause either signs of increased intracranial pressure or localizing symptoms (hemiparesis, aphasia, hemianopsia, Jacksonian convulsions, unilateral ataxia, etc.) it may long escape notice. Accordingly, it enlarges in spite of the fairly vigorous reaction and encapsulation with which the brain responds to it, until finally it causes pressure symptoms (headache, bradycardia, stupor, choked disk, and possibly even the usual signs of deep penetration into the temporal lobe, i.e., an homonymous hemianopsia). If situated on the left side in a right-handed patient, it may cause aphasia. With deep involvement of the cerebellum, nystagmus and ipsilateral ataxia will usually be provoked together with high-grade choked disks.

In a well encapsulated abscess of long standing, marked bradycardia of fifty to sixty beats per minute and hypothermia ( $95^{\circ}$  to  $96^{\circ}$ ) are characteristic, even more so than with intracranial tumors. In

cerebellar abscess, the ipsilateral ataxia of the extremities is striking and more clear-cut than in most cases with cerebellar tumor.

Given a patient with a history of a definite infection adjacent to the head or remote from it in the recent past, who develops signs of increased intracranial pressure associated with stupor and choked disks with or without localizing neurological signs, a brain abscess must be diagnosed clinically and operation promptly carried out. A lumbar puncture in such cases is usually to be avoided, particularly if choked disk is present. A ventriculogram for precise localization may be necessary in the absence of localizing signs. Cases of primary frank pyogenic or meningococcic meningitis rarely, for some reason, develop brain abscesses of any appreciable size or of surgical significance, possibly (in the fatal cases) because death occurs too soon after the meningitis develops.

As in the diagnosis of many lesions in any branch of medicine, it is the "awareness" of the diagnostician to the possibility of an abscess being present that makes for success in the recognition of these treacherous lesions so that operation will be carried out before profound coma develops in which condition operation is, as a rule, of little or no avail.

#### TREATMENT

Treatment consists of evacuation and adequate drainage of the abscess at the optimum time. There are several acceptable methods utilized in various clinics: (1) Drainage of the abscess through a small trephine opening in the skull and immediate or delayed insertion of a soft rubber catheter into the abscess, which is left *in situ* usually from four to six weeks. (2) In certain rare instances, according to Cairns and Donald,<sup>8</sup> thickwalled, multilocular abscesses cannot be treated satisfactorily by drainage but require dissection and total removal or marsupialization. Abscesses in which the pus is thick are probably best treated through an osteoplastic flap, ac-

cording to these authors. (3) Single or repeated tapping of the abscess without drainage of any kind as recommended by Dandy<sup>9</sup> who believes that in an encapsulated abscess the brain needs only a relief of tension to enable it to overcome the infection. (4) Unroofing or marsupialization of the abscess, i.e., removing the overlying brain cortex which covers the abscess, as proposed by King<sup>10</sup> in 1924, and in 1934 and 1938 by Horrax<sup>11</sup> (after Cushing). King stated that by his method (marsupialization) the abscess is everted and obliterated by the associated increased intracranial pressure, which is in fact the case; but this last method is of value only in quite superficial well encapsulated abscesses of many weeks' standing, preferably located in the anterior portions of the frontal lobes, remote from the motor cortex.

The essential problem in the surgical management of brain abscess is to wait long enough for the abscess to encapsulate, but not to postpone operation to the point that rupture into a ventricle or the subarachnoid space is imminent or has already occurred. The finest surgical judgment is required in determining when to operate in any individual case.

#### MORTALITY AND RESULTS

It must be recognized that certain abscesses are inherently unfavorable from the beginning of their existence. In such a group of cases the mortality is practically 100 per cent. This fundamental point should be kept in mind in considering the mortality percentages quoted from any clinic, as some reports include all types of brain abscess; others discuss only the *favorable* type. In multiple brain abscesses and in poorly defined abscesses with little or no capsule formation, but with marked edema and purulent encephalitis about the abscess, a fatality is almost to be expected and can scarcely be avoided by any operative procedure. In some of the deep abscesses (5 to 6 cm. or more beneath the

cortex) of the cerebral hemispheres, a fatality occurs due to difficulties in accomplishing adequate drainage and inoculation of adjacent white matter in attempts to establish drainage. *It is with the more or less superficial cerebral and cerebellar abscesses with at least fairly well defined capsules that operation at the optimum time is life-saving.* In 1927, Dr. Coleman<sup>12</sup> reported a series of fourteen patients with chronic brain abscesses, twelve of whom recovered. Simple tapping and drainage with a soft rubber catheter was used in each case. All of these abscesses were in the cerebral hemispheres, being located in the temporal, frontal, and parietal lobes. At a later date, he<sup>13</sup> recorded a series of twenty-eight cases of brain abscess with twenty-one recoveries, drainage being accomplished very simply and adequately in each case with a small soft rubber catheter or silver cannula. Horrax,<sup>11</sup> in 1938, published a study of thirty patients with brain abscesses (favorable and unfavorable) treated by him during a period of nine years. He stated that, in the *favorable* group, the prognosis should be good (fifteen of eighteen patients recovered) with a mortality rate not exceeding 10 to 20 per cent, instead of the generally accepted death rate of 30 to 40 per cent. This desired mortality percentage (10 to 20 per cent) in the so-called favorable group is probably concurred in by most neurosurgeons today.

Quite recently (1942) Grant<sup>14</sup> has collected a series of one hundred cases of brain abscess observed at the University of Pennsylvania Hospital. Fifty-three patients (53 per cent) died, but it should be stated that a fair percentage of those patients were of the unfavorable group, i.e., (1) multiple abscesses of the brain, (2) poorly defined or non-encapsulated abscesses, (3) cases having proved bacterial meningitis at the time of operation as demonstrated by lumbar puncture before drainage of the abscess. Grant found the postoperative mortality for closed drainage and open drainage to be the same (33 per cent) in his series of cases.

All neurosurgeons agree that, if possible, a brain abscess should not be attacked until encapsulation has occurred. Three to four weeks from the onset of intracranial symptoms, therefore, should be permitted to elapse before the purulent cavity is evacuated, although, that certain abscesses will never become well encapsulated is frankly conceded; and indeed sometimes the surgeon is forced to operate before that time, chiefly because of developing stupor, convulsions, or marked bradycardia associated perhaps with severe headache and vomiting.

We believe that the initial attack upon a brain abscess usually should be carried out through a small trephine opening directly over the lesion (a previous ventriculogram may be necessary) with the insertion of a drainage tube (French rubber catheter) whether the abscess is in the cerebellum or the cerebrum. This procedure alone will result in a cure in many instances, the tube being left *in situ* for several weeks. If this method does not produce satisfactory results, a resort must be had to more radical methods (?) of marsupialization involving the possibility of more serious neurologic sequellae (convulsions, hemiparesis, aphasia, etc.) after recovery from the infection has occurred.

#### CONCLUSIONS (AS RELATED TO THERAPY)

Conservative surgical treatment, i.e., tapping alone or tapping with catheter drainage through a small trephine opening in the skull produces the best results in most cases in the treatment of brain abscess. The use of wide-open drainage has not lowered the operative mortality in comparison with more conservative methods (Grant). In follow-up examinations, too, a much higher percentage of patients are returned to their former occupations following the use of the simpler procedures for instituting drainage than when a more radical technic involving wide destruction or removal of overlying brain tissue is employed. Furthermore, the less radical the surgical treatment of a brain abscess, the less likely are convulsions to occur

months or even years after operation, a postoperative complication reported to be as high as 53 per cent in certain clinics.

Needless to add, the appropriate sulphonamide should be administered by mouth or parenterally in rather large doses immediately upon establishing the bacterial diagnosis in any individual case of brain abscess or even before such a diagnosis is made when a previous adjacent or remote infection (the usual course of events) has been treated before intracranial symptoms supervene. Its use locally in or about the brain abscess itself seems to predispose the patient to postoperative convulsions which otherwise might not occur and, for that reason, such drugs are usually not so employed.

#### REFERENCES

1. EAGLETON, WELLS P. Eagleton's Index (Abstracts of Progress in Intracranial Lesions Related to Aural and Nasal Conditions). Private printing, March 11, 1941.
2. ROSENOW, E. C. Quoted by Eagleton in *Arch. Oto-laryngol.*, 8: 193, 1928. (Intradural Diseases in Relation to Rhinology and Otology).
3. WEED and SABINE. Quoted by Eagleton in *Arch. Oto-laryngol.*, 8: 193, 1928. (Intradural Diseases in Relation to Rhinology and Otology).
4. KING, J. E. J. Brain abscess. *Ann. Surg.*, 103: 647, 1936.
5. PENFIELD, WILDER. Quoted by Dr. King.<sup>4</sup>
6. GRANT, F. C. The mortality from abscess of the brain. *J. A. M. A.*, 99: 550, 1922.
7. BAGLEY, CHARLES, JR. Brain abscess with pathological observations. *Surg., Gynec. & Obst.*, 38: 1, 1924.
8. CAIRNS, H. and DONALD, D. The diagnosis and treatment of abscess of the brain. *Proc. Roy. Soc. Med.*, 27: 1643, 1934.
9. DANDY, W. E. Treatment of chronic abscess of the brain by tapping. *J. A. M. A.*, 87: 1477, 1926.
10. KING, J. E. J. The treatment of brain abscess. *Surg., Gynec. & Obst.*, 39: 554, 1924.
11. HORRAX, G. (a) A method for the treatment of certain chronic encapsulated brain abscesses. *Surg. Clin. North America*, Lahey Clin. No., p. 1179. Oct., 1934. (b) Brain abscess. *Brit. J. Surg.*, 25: 538, 1938.
12. COLEMAN, C. C. The treatment of abscess of the brain. *Arch. Surg.*, 18: 100, 1929.
13. Idem. (a) Operative Surgery (Horsley and Bigger). 4th ed. vol. II, p. 1210, St. Louis, 1937. C. V. Mosby Co. (b) Brain abscess. A review of 28 cases with comment on the ophthalmologic observations. *J. A. M. A.*, 95: 568, 1930.
14. GRANT, F. C. End results in 100 consecutive cases of brain abscess. *Surg., Gynec. & Obst.*, 75: 465, 1942.

# COMPLICATED TRAUMATIC DISLOCATIONS OF THE HIP

WELLINGTON D. GRIESEMER, M.D.

Chief of Fracture and Orthopedic Service, St. Joseph's Hospital

READING, PENNSYLVANIA

K EY and Conwell state that "Traumatic dislocations of the hip are quite rare and comprise only from two to five per cent of all dislocations, the exact percentage varying slightly in different series. This is in marked contrast to the shoulder where over fifty per cent of all dislocations occur." This largely follows our experience.

The simple, uncomplicated dislocation can usually be reduced by one of the methods in general use—Allis, Leadbetter, Bigelow or Stimson. The cases complicated by fractures, either of the femur or of the acetabulum and pelvis often are difficult to manage. The four cases to be reported here were of the complicated variety and presented problems of treatment which we believed would be of interest.

## CASE REPORTS

CASE I. B. W., a white male, forty-four year old painter, fell a distance of thirty feet on April 6, 1942, and was immediately admitted to the Hospital in profound shock. A Thomas splint had been applied to the right leg. Examination showed a deformity at the right hip with the extremity internally rotated and shortened. The splint was retained and the patient treated for shock. Further examination indicated injury to the left side of the chest. X-rays revealed depressed fractures of all of the true ribs except the first. The right femur was dislocated posteriorly, being markedly displaced upward and carrying with it a fragment of the roof of the acetabulum.

On account of the serious condition of the patient, no immediate attempt at reduction was made. Russell traction was applied as a temporary measure, and was continued for several days until the patient had recovered from shock. Another x-ray was made preliminary to trying reduction. However, this was not necessary as a satisfactory reposition of

the dislocation had resulted with the acetabular fragment in a good position. This traction was continued for six weeks, with interval x-rays to check position. No serious complications arose from the fractured ribs, except for a moderate degree of subcutaneous emphysema. He was discharged from the hospital after eight weeks, having been out of bed previously for several days.

A caliper brace was procured in the hope of early walking. However, this was delayed on account of deep pressure ulcers on the anterior aspect of the ankle. X-rays at discharge showed retention of reduction with the fragment of the acetabulum forming a well designed shelf. Motion in the hip was free and painless. He was able to return to a lighter type of work in October 1942. This patient has now returned to his former type of work. X-ray examination in April, 1943, showed no abnormal changes in the head and neck of the femur.

CASE II. M. K., female aged twenty-nine years, a supervising nurse, was injured on April 21, 1942, while driving a car in a nearby town. She was admitted to the hospital twenty-four hours after the accident, with a Thomas splint applied to the left leg and dressings to right foot and leg. Examination showed deformity of the left hip with some internal rotation of the thigh and shortening. There was a marked contusion about the left knee. In the right leg below the knee there was seen a deep wound, and in foot a deformity of the third, fourth and fifth toes. X-rays had been made in hospital near the scene of the accident and showed a posterior dislocation of the left hip, accompanied by extensive fractures of the acetabulum and ilium. Toes of the left foot were fractured; examination of the leg was negative.

The patient was prepared for anesthesia and early next day an unsuccessful attempt was made to reduce the dislocation. The Leadbetter method was used but failed because the patient was very muscular and satisfactory relaxation could not be obtained even under deep anes-



FIG. 1. CASE 1. B. W. Posterior dislocation with fracture of roof of acetabulum, April 6, 1942.



FIG. 2. CASE 1. Shows dislocation reduced with fragment forming a shelf above and behind the head of femur, June 30, 1942.



FIG. 3. CASE II. M. K. Posterior dislocation with displaced fracture of acetabulum and ilium, April 22, 1942.

thesia. The fractured toes were reduced and a cast applied. The patient was then returned to bed and Russell traction was applied to the

was made and the leg gradually carried into wide abduction at the same time making pressure over the greater trochanter. While this



FIG. 4. CASE II. Dislocation reduced with improved position of fragments, May 18, 1942.

left leg and retained for several days, when another unsuccessful attempt to reduce was made. Caution was used in the force applied because of fear of injury to soft parts, especially the sciatic nerve, since the head of the femur was so grossly displaced posteriorly and pushed upward. Skeletal traction was then instituted by insertion of a steel pin through the lower third of the femur with the hope of overcoming muscle spasm with possible reduction of the dislocation. X-ray studies were made every third day to check progress. These showed a gradual pulling down of the femur but with no reduction. Since this was a seriously complicated dislocation with an unfortunate prognosis if left unreduced, open operation was under consideration. As this is a formidable procedure, consultation was requested before coming to a decision. Dr. H. H. Ritter was asked to see the patient and it was then decided to make one more attempt at reposition.

Under general anesthesia, a strong traction

maneuver was being carried out, there was a distinct click as the femoral head was apparently forced into what remained of the acetabular cavity. The leg was then strongly rotated internally and x-rays immediately taken showing satisfactory reduction. Traction was maintained in this position with interval x-rays for eight weeks. During this period, the patient was encouraged to move the hip carefully, limited by any pain produced. In a few days pain became very slight so that motion could be more active. The final x-ray showed maintained reduction with apparent reformation of an acetabulum. A caliper brace was then applied and patient allowed to walk, first with the added support of crutches and later the use of a cane. On August 1, 1942, she returned to her full duties, with motion in hip free and painless. On November 1, 1942, retakes showed the reduction complete and no joint disorder. There was noted a small fragment still free above the acetabulum. At the



FIG. 5. CASE II. Complete reduction maintained with acetabulum well formed and no evidence of pathological disturbance. November 30, 1942.

time of this report, she has dispensed with the use of a cane and carries out all her duties wearing the brace. X-ray examination in Octo-

skin irritation. The patient's condition had then improved sufficiently to try reduction. There had resulted some improvement from

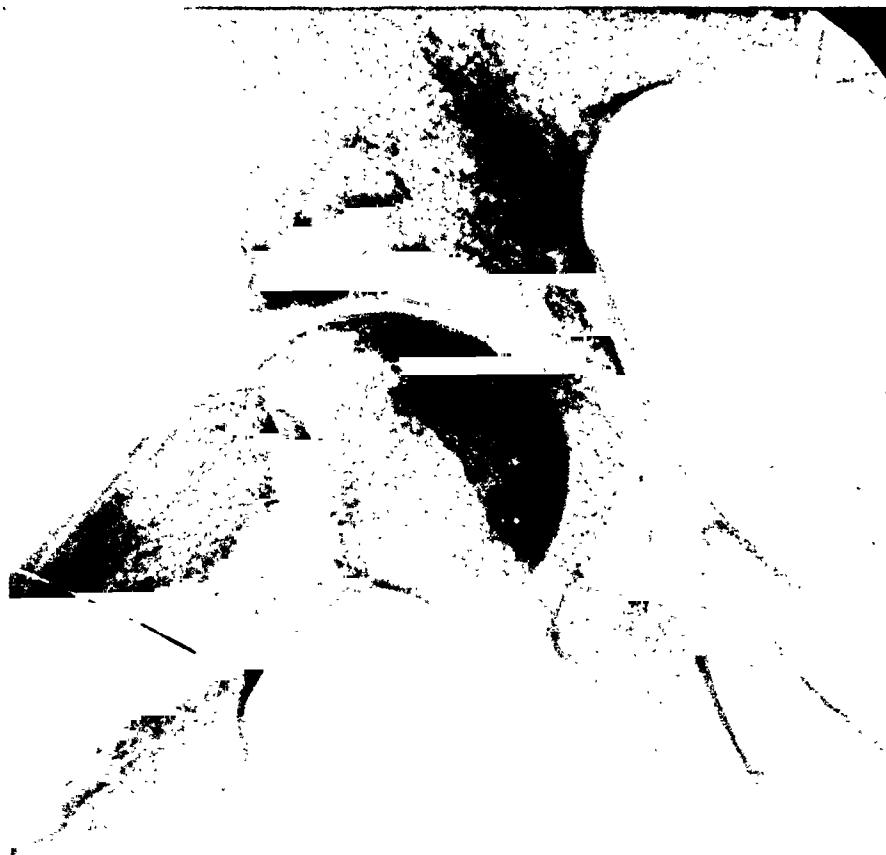


FIG. 6. CASE II. Lateral view showing acetabulum in better detail, November 30, 1942.

ber, 1942, indicated no abnormal changes. A recent report states that she has had no resulting disability.

**CASE III.** H. F., a white male, twenty-nine years old, was admitted on May 27, 1942, immediately after a road accident. He was in severe shock. A Thomas splint had been applied to his right leg. There were numerous lacerations about the face and hands and a deep wound in the posterior thoracic region. Marked deformity was noted at the right hip with the thigh internally rotated and apparently shortened. X-rays showed a posterior dislocation of the hip with marked displacement combined with extensive fracture of the acetabulum and ilium.

On account of the extreme shock, no immediate attempt at reduction was made. The lacerations were treated and Russell traction applied to the right leg. However, this had to be abandoned within several days on account of

traction and under light general anesthesia on May 31, 1942, reduction followed strong traction, abduction and internal rotation. To maintain this position, skeletal traction was instituted by inserting a steel pin through the lower third of the femur. Interval x-rays were made while traction was maintained until July 24, 1942. During this period, active motion of the hip was encouraged. On August 9, 1942, the patient was allowed out of bed on a chair and left the hospital on August 19, 1942, wearing a caliper brace and walking with crutches. His progress was steady so that by October 6, 1942, he was able to return to his work as an electrician. He had no pain or disability in the hip. On November 18, 1942, x-ray retake showed reduction maintained with good joint outline and fracture of ilium well healed. At the time of this report, January, 1943, he was at work daily, wearing his brace and had no pain or disability at the hip. This patient has

continued at his former occupation with no disability. Several retake x-rays have shown no abnormal changes in the head and neck of the femur.

until the patient had recovered from his shock. On the second day, an attempt at reducing the dislocation was made. Because very definite resistance was encountered while manipulating,



FIG. 7. CASE III. H. F. Posterior dislocation with marked comminuted fracture of acetabulum and displaced fracture of wing of ilium, May 27, 1942.

CASE IV. M. F., a white truck-driver, aged eighteen years, was injured in a road accident on October 28, 1942, sustaining a comminuted fracture of the shaft of the right femur with marked shortening and displacement. There was also marked deformity of the left hip region with the thigh internally rotated and apparently shortened. X-rays showed a posterior dislocation of the left hip with a fracture fragment visible in the region of the acetabulum. The roentgenologist was not able to determine definitely the origin of this fragment even after several retakes. The severe shock present prevented any immediate reduction of the fracture or dislocation.

Russell traction was applied to both limbs

excessive force was not used for fear of injuring soft parts. No reposition was obtained. Skeletal traction through the lower third of the femur was then instituted. Two additional attempts at reduction at intervals of several days were unsuccessful. It was then decided to continue the skeletal traction for a further period hoping to avoid open operation. Interval x-rays indicated that some progress was being made in pulling the femur down, but a final effort to reduce failed. After allowing a period of five days for the parts to recover from the effects of manipulation and to prepare the patient both locally and in general condition, open operation was done. This was three weeks after the accident. Exposure was made by use

of Smith-Petersen incision and showed a marked posterior displacement of the femur with a shell fragment of the head still partially

it is planned to have him out of bed soon and to supply a caliper brace for his left leg.

Since the above report was made a one inch

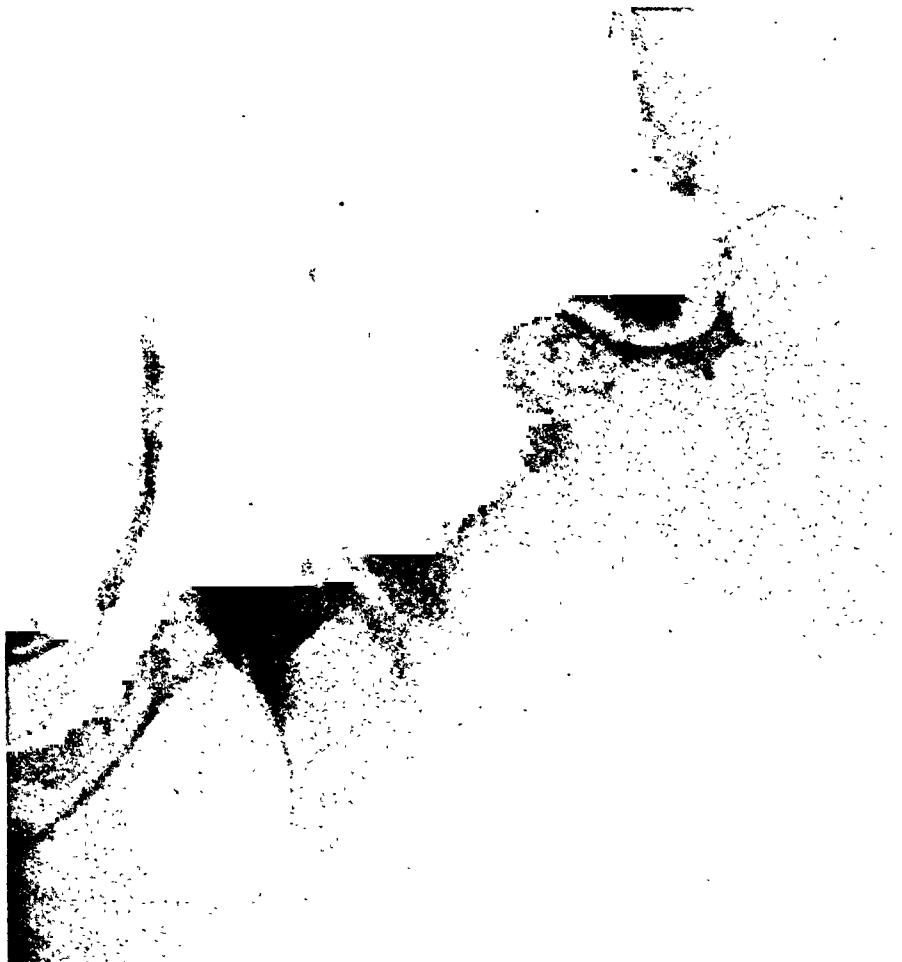


FIG. 8. CASE III. Dislocation reduced with fractures in improved position and acetabulum reformed, July 15, 1942.

attached and impinged on the upper rim of the acetabulum. This was evidently the condition which prevented reduction by manipulation. After some difficulty the fragment was removed and the acetabulum exposed, removing the remains of the torn ligamentum teres. The hip was then reduced and a cast applied to the entire extremity incorporating the pin which had been inserted for skeletal traction. The patient reacted well and one week later, open reduction was done on the fracture of the right femur, with a cast applied and incorporated in the cast on the left hip. The cast was removed from the left hip eight weeks after operation and active motion encouraged. On account of the fracture of the right femur, it was still necessary to keep him in bed. However, as x-rays now (January, 1943) show good position maintained in both areas of injury,

shortening of the right femur was noted but with no disability in the left hip. X-ray examination in June, 1943, showed no abnormal signs in the head and neck of the femur. The patient has been working at a lighter type of work since October 1, 1943. Further x-ray studies have been advised.

#### COMMENTS AND CONCLUSIONS

Complicated traumatic dislocations of the hip present serious difficulties in treatment. Attempts to reduce should be made as early as possible, depending on complicating conditions. Force used should be carefully controlled to avoid injury to soft parts, especially the sciatic nerve. If manipulation is unsuccessful, traction either by the Russell method, which may



FIG. 9. CASE III. Reduction maintained with acetabulum well formed and protected by an extensive shelf, November 20, 1942.

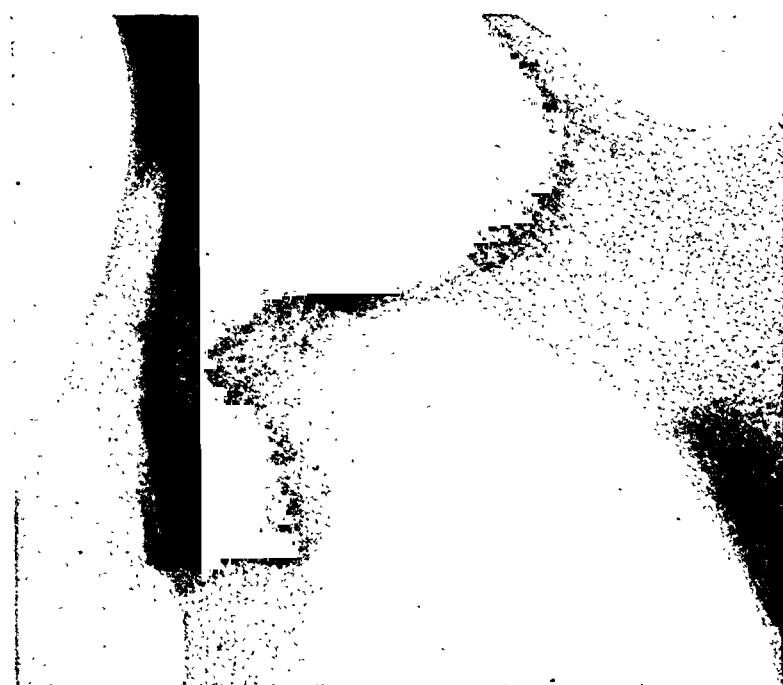


FIG. 10. CASE IV. M. F. Posterior dislocation with loose fragment apparently in acetabulum, November 15, 1942.

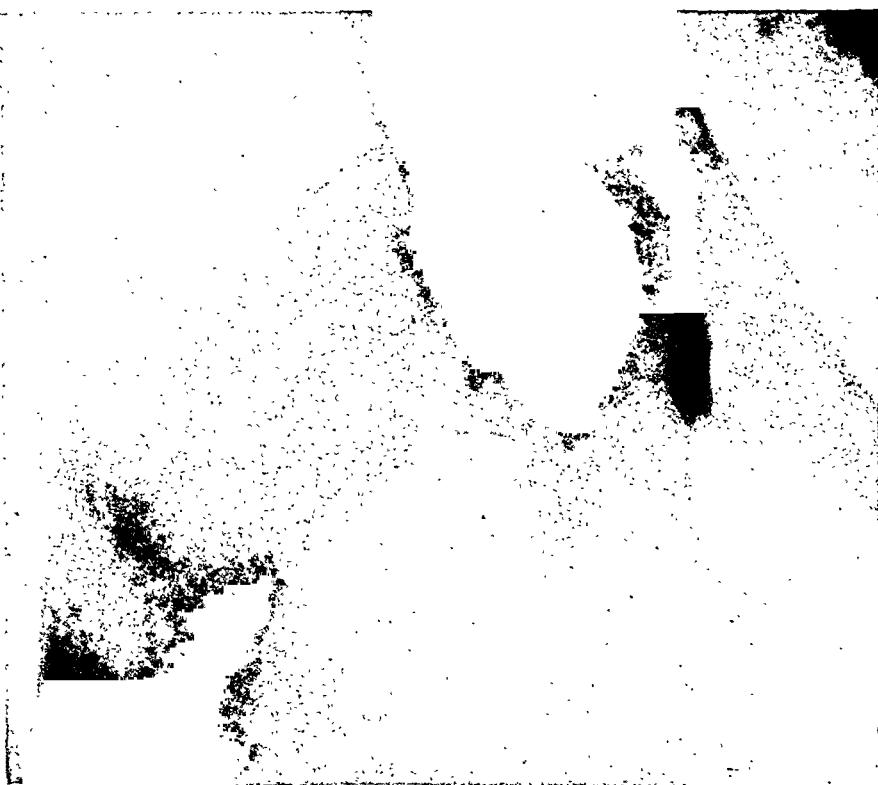


FIG. 11. CASE IV. Reduction after operation, December 15, 1942.

be sufficient in some cases, or by skeletal traction through the femur, should be instituted.

progress and further attempts to reduce should be tried when conditions indicate. If these fail, open operation should follow,

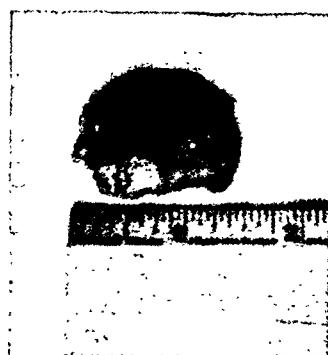


FIG. 12. CASE IV. Fragment removed from posterior rim of acetabulum.



FIG. 13. CASE IV. Severe type of fracture of right femur complicating the dislocation of left hip.

We believe that skeletal traction is preferable, especially in complicated displacements, since by this method one avoids the possibility of pressure ulcerations following prolonged traction, which occurred in our treatment of the patient in Case I. During this period of traction, frequent x-rays should be made to check

preferably within three weeks, as operation becomes increasingly difficult. Following reduction, fixation by cast is indicated in the simpler cases. In others, as in Case II, where there is extensive fracture of the pelvis and acetabulum, skeletal traction should be continued for eight weeks. Active motion of hip and knee should be encour-

aged to the degree possible and should be limited by pain. Numerous x-rays are required to follow progress.

even in the simpler cases. In the cases reported here, it is of course too early to determine the end-results, but they will



FIG. 14. CASE IV. Reduction and wiring of fragments.

FIG. 15. CASE IV. Lateral view.

We believe that all patients should be fitted with a caliper brace to allow walking without direct stress on the joint, as aseptic necrosis of the head with associated joint changes may follow in a certain number of cases, even if not of a complicated type. These changes are due to the interference with circulation caused by the damage to the ligamentum teres and other structures carrying nutrient circulation. Such disturbances have been known to occur even three to four years after injury. Follow-up care is, therefore, very important, requiring x-ray study at certain intervals for early detection of such changes. With these possibilities, prognosis must be guarded

be followed, if possible, for at least two years before final evaluation will be attempted.

#### REFERENCES

1. FUNSTEN, R. V. et al. Two unusual traumatic dislocations of the hip. *J. Bone & Joint Surg.*, 24: 443-446, 1942.
2. WATSON-JONES. Fractures and Other Bone and Joint Injuries. 2nd ed. The Williams & Wilkins Co., 1941.
3. KEY and CONWELL. Fractures, Dislocations and Sprains. 3rd ed. C. V. Mosby Co., 1942.
4. BANKS, S. W. Aseptic necrosis of the femoral head following traumatic dislocation of the hip. A report of nine cases. *J. Bone & Joint Surg.*, 23: 753-781, 1941.
5. WALKER, WM. A. Traumatic dislocations of the hip joint. *Am. J. Surg.*, 50: 545-549, 1940.

# THE MANAGEMENT OF VARICOSE VEINS IN ARMY PERSONNEL\*

MAJOR A. S. WHITE, M.C., CAPTAIN J. J. HABERER, M.C.  
AND  
MAJOR SAM GENDEL, M.C.  
FORT ORD, CALIFORNIA

TREATMENT of varicose veins in the Army presents problems not encountered in civil practice. The first problem is the more difficult differential diagnosis. Pain, aching, and tiredness in the legs following marching is most common among soldiers whether varicose veins are present or not. It is natural for soldiers, especially during the preliminary phases of training, to magnify these symptoms in order to avoid the more arduous work. In addition, a certain by no means small group of psychoneurotic patients combine these symptoms and small varicosities that are present with their many psychoneurotic complaints to produce a confusing clinical picture which will not respond to varicose vein therapy. Second, there is need for a treatment which will be rapid as well as effective. Cure must be permanent if possible. Palliative measures which involve repeated hospitalization or numerous outpatient visits interfere with military training and must be avoided. Patients must be returned to duty able to do full duty.

An effective plan of diagnosis and treatment must provide (1) criteria for selection of cases which require treatment, (2) simple diagnostic maneuvers which can be carried out with the minimum of equipment, and (3) an adequate surgical technic which will allow return to full duty within a short period.

## CRITERIA FOR SELECTION OF CASES

Military practice demands that patients operated upon for varicose veins must subsequently be able to do full duty.

Operations on soldiers, who are to be reclassified for other conditions, are useless. There are four principal groups of patients that must be excluded in the selection of cases. These are: (1) the psychoneurotic, (2) those with associated orthopedic conditions, (3) those with associated peripheral vascular disease, and (4) those, who for want of a better term, are classified as myalgic asthenia.

*Patients with Psychoneurosis.* The psychoneurotic patient is a daily problem in a varicose vein clinic. His veins may be mild or severe but his symptoms are manifold. Complaints referable to the legs are many and bitter. But symptoms are by no means confined to the legs. They can and do complain of everything, but most often present headache and dizziness, transient pains of the back, shoulders and neck, palpitation and breathlessness. These patients must definitely not be treated for their varicosities. They should be reclassified to limited duty or discharged from the service for their psychoneurosis. In a busy clinic it is not always easy to segregate these patients. In addition to careful questioning about complaints other than the legs, it is useful to ask two questions: first, how much schooling has the patient had, and second, has the patient ever had a nervous breakdown. Less than fifth grade schooling or positive answers to the second question should prompt a neuropsychiatric investigation before surgery, regardless of the severity of the varicose veins.

*Patients with Associated Orthopedic Conditions.* Varicose veins are often seen in

\* From the Peripheral Vascular Branch Surgical Service, Station Hospital, Fort Ord, California.

patients with associated orthopedic conditions. A careful evaluation must be made as to whether the symptoms are due to the varicosities or whether they are actually due to the orthopedic disorder. A list of orthopedic diseases seen in patients whose entrance complaints have been referable to varicose veins is imposing. Pes planus, pes cavus, hallux valgus and metatarsalgia have been the most common. Muscle sprains of the calf and pain on marching in the region of the tibialis anticus muscle are seen frequently. More rarely march fracture, tenosynovitis of the Achilles tendon, chronic sprain of the knee, and low grade sciatica are found. A muscle hernia or hip disease can be the essential complaint. Meralgia paresthetica has not been infrequent as the true cause of symptoms. If any one of these conditions is present, that condition must be treated first.

*Patients with Associated Peripheral Vascular Lesions.* Associated peripheral vascular disease is a definite contraindication to surgical treatment of varicosities in the Army. These patients with intermittent claudication due to early Buerger's disease, Raynaud's disease, or arteriosclerosis, should be reclassified to limited duty or discharged from the service. While some authors<sup>1</sup> have rightly claimed that the peripheral arterial circulation is improved following saphenous ligation, the improvement is never marked enough to allow such a patient to return to full duty status.

*Patients with Myalgic Asthenia.* These are patients who, from heredity or environment, have insufficient strength and muscular development to withstand the arduous work of full-duty Army life. Often, they are men of over thirty-five years of age. Their habitus is such that they are unable to cope with the long marches and other physical labor demanded of a soldier, despite a careful conditioning program. They may not be psychoneurotic, and may have no physical illness, but they are as physically unable to compete with the average soldier as the ordinary well adult

would be physically unable to compete with a first-class track man or a professional fighter. This type of patient rarely presents himself with the complaint that he is unable to keep up with his organization. He selects whatever physical disability is present and explains his inadequacy upon that basis. When this type of man has varicose veins he will naturally attempt to explain his difficulty upon the varicose veins. It is as much a mistake to operate upon these patients as it is to force them to perform full duty. They should be reclassified to limited service.

With these four groups eliminated in the consideration of each patient, the soldier suitable for surgery should have complaints referable to varicose veins alone and should be able to return to full duty following surgical treatment.

#### SIMPLE DIAGNOSTIC MANEUVERS

The primary pathology of varicose veins is an incompetent valve between the deep and superficial venous systems. These systems communicate directly by junctions between the long saphenous and common femoral, and between the short saphenous and popliteal. They are also connected by numerous perforating veins. Incompetent valves may occur at these two junctions or in any of the perforators. The purpose of any surgical procedure is the destruction of the open communication between the two systems by removal of the segment of vein containing the defective valve. Results obtained by surgery are directly dependent upon the preoperative localization of any and all incompetent valves.

Trendelenburg,<sup>2</sup> in 1891, first recognized the pathologic physiology and described the classical test to determine the state of the saphenofemoral valve. Since that time, and especially within the last ten years, when articles on varicose veins have appeared at the rate of one per day, innumerable tests and manipulations have been described for the determination of the site of the defective valve. These numerous

tests and the names attached to them have confused rather than simplified the diagnosis. The following routine avoids the use of "named tests," and gives an accurate diagnosis simply and rapidly.

The diagnosis of varicose veins is made by inspection, palpation, and manipulation. Inspection and palpation will locate the varicosities and help locate the defective valve. A bulge at the upper limit of a nest of varicosities is frequently the site of an incompetent perforator. The presence of a localized "nest" of varicosities may serve to bring attention to a particular branch of the great saphenous. After noting the distribution and severity of the varicosities, the answers to the following four questions determine the subsequent treatment: (1) Is the arterial supply adequate? (2) Is the deep venous circulation patent and adequate? (3) Is the saphenofemoral junction, or valve, competent? (4) Are there any incompetent perforators, and if so, where are they?

*Is the Arterial Supply Adequate?* Our test for arterial circulation is confined to palpation of the peripheral pulses, dorsalis pedis, posterior tibial and popliteal. A deficient arterial supply is a definite contraindication to surgery. There is some evidence to indicate that eradication of varicose veins improves a deficient arterial circulation.<sup>3</sup> However, in the military service such patients are not fit for full duty and treatment of varicosities is contraindicated.

*Is the Deep Venous Circulation Patent and Adequate?* To determine the patency of the deep venous circulation the extremity is wrapped from the toes to the groin in stockinette bandage cut on the bias (or Ace bandage). The patient is then allowed to walk. If the patient returns with the bandage in place and has no discomfort, the deep venous circulation is intact. When the deep circulation is not adequate, compression of the superficial veins or collateral circulation will produce pain, and surgery is contraindicated.<sup>4</sup>

*Is the Saphenofemoral Junction, or Valve,*

*Competent?* A single tourniquet test determines the state of the saphenofemoral valve. The patient is told to lie down, his extremity elevated, and the veins emptied. A tourniquet is applied just below the fossa ovalis and the patient instructed to stand. Ordinarily, it will take forty to sixty seconds for the varicose veins to fill from behind through normal channels. If while the veins are empty, releasing the tourniquet causes the veins to fill immediately, the patient has an incompetent saphenofemoral junction or valve.

*Are There Any Incompetent Perforators, and if so, Where Are They?* Two tourniquets are employed to determine the presence and location of the incompetent perforator. After emptying the varicosities and applying the tourniquet just below the fossa ovalis, the patient is made to stand. If the varicosities fill within thirty-five seconds with the tourniquet in place, an incompetent perforator is present. This being the case, the tourniquet is released and with the patient in a supine position the varicosities are again emptied and the tourniquet applied. A second tourniquet is now applied about four inches below the first and the patient is again instructed to stand. If the veins again fill below the second tourniquet within thirty-five seconds, the procedure is repeated with the second tourniquet at a lower level. This procedure is repeated until the veins fill between the two tourniquets, indicating the perforator has been passed. By reapplying and gradually approximating the tourniquets and narrowing the field in which the veins fill, the exact site of the perforator is determined and marked. Not infrequently, additional incompetencies are present and are revealed by a filling of the veins below the second tourniquet. These additional perforators are located in a similar manner. In performing these tests, the examiner should bear in mind the high instances of perforators in the region about the knee, and the frequent incompetency of the short saphenous vein at its junction with the popliteal vein.

## SURGICAL TECHNIC

Abundant evidence has accumulated to demonstrate the futility of injecting sclerosing agents into varicose veins in the presence of incompetent communications between the superficial and deep venous systems.<sup>5,6</sup> The pressure head upon the injected varicosities from the deep system either prevents thrombosis or results in early recanalization. Adequate treatment is based upon the surgical destruction of any and all open communications between the two systems by removal of the segment of vein containing the defective valve. Following this, and only then, is injection therapy indicated. Depending entirely upon the preoperative findings, a high ligation of the great saphenous, ligation of the short saphenous, ligation of an incompetent perforator, or a combined procedure is indicated.

*Operative Technic.* Anesthesia is obtained by skin infiltration of local procaine. A transverse incision is made parallel to and two-finger breadths below the inguinal ligament with its center one-finger breadth medial to the pulsation of the femoral artery. The incision is carried through the well developed superficial fascia using considerable care as the great saphenous lies immediately beneath. The great saphenous is isolated together with its constant tributaries, the superficial external pudendal, the superficial inferior epigastric and superficial external circumflex iliac veins. The saphenous and all its branches should be isolated and dissected free before any are severed.<sup>7</sup> The tragedy of ligating the femoral artery or vein is thus avoided. Dissection is carried distally for about 6 cm. and the vein doubly clamped and ligated. All branches are then individually clamped and ligated. After freeing the posterior surface of the proximal segment, double clamps are applied just below its entrance into the femoral vein. The vein is transfixed proximal to the first clamp with a needle and ligated. Another ligature is now tied just proximal to the first, thus sealing off any break in the intima of

the vein wall. The segment is excised and closure is in layers. All buried sutures and ligatures are of chromic catgut No. 00. Interrupted silk is used for the skin.

If an incompetent perforator is present its location has already been marked before surgery. Through a transverse incision the vein is exposed and the communicating vein looked for. Here general traction upon the varicose vein will often cause the deep fascia to bulge around the point of perforation and will aid in localizing these perforating veins. The perforator is ligated as it comes through the deep fascia and the superficial vein is resected as much as is possible through the incision. Short saphenous ligations are done using a similar technic but the incision is made at the lower margin of the upper third of the leg posteriorly so as to catch the short saphenous as it passes through the crural fascia. Following the operation a dry dressing is placed over the wound and stockinette bandage is applied to the extremity reaching from the toes to the groin. This aids in the collapse of the veins and promotes thrombosis.

*Postoperative Treatment.* Walking is obligatory from the day of the operation. This reduces stasis and the danger of embolism.<sup>8,9,10</sup> The patient is usually discharged to full duty in about ten days to two weeks. He returns to the out-patient clinic the week following discharge where he is tested for sensitivity to sodium morrhuate by the injection of  $\frac{1}{2}$  cc. Following this, injections of 2 to 4 cc. are given at weekly intervals. A course of four to eight injections is generally sufficient.

Injection of sclerosing solution at the time of surgery is not done, despite its widespread use in many clinics. The advisability of such a procedure is questionable for the following reasons:<sup>11</sup> (1) The occasional severe reaction following this type of injection forces the patient to remain in bed. It is more important to keep the patient ambulatory than to hurry the sclerosing of the veins, for bed rest more than any other factor predisposes to

pulmonary embolism. (2) The few deaths reported following varicose vein surgery have been subsequent to injection of large amounts of sclerosing fluid at the time of ligation. (3) When perforating veins are excised, previous injection of the great saphenous may cause sclerosing solution to leak out into the lower wound and predispose to infection and sloughing of the wound. (4) To be effective the dose must be large. To avoid reaction from a large dose a test injection must be given first. This test dose may cause sufficient reaction to delay surgery and prolong hospitalization.

#### STATISTICAL SUMMARY

A total of 1,131 cases of varicose veins were seen as out-patients in the two years ending March, 1943. Of these only 340 were admitted to the hospital for study. Following more careful investigation 126 were eliminated as candidates for surgery, making a total of 917 rejected for surgery and 214 operated upon.

In the group of 214 patients operated upon, 206 had high saphenous ligation and of these 113 were bilateral; 106 cases had incompetent perforating veins, an incidence higher than that usually reported; seventy-five cases had one perforator and thirty-one had two, making a total of 137 perforators in the entire series. Distribution of the perforators was as follows: about the knee seventy-eight, short saphenous thirty-nine, upper leg twelve, and mid-thigh eight.

#### COMMENT

As can be seen, the criteria for selection of cases as outlined above was instrumental in eliminating 917 of 1,131 cases. For the proper treatment of Army personnel this is of major importance. Indiscriminate surgery in the rejected group would compound time loss, unnecessarily increase expense and aggravate postwar pension claims.

The simple diagnostic maneuvers de-

scribed are sufficiently accurate to allow the localization of a high percentage of incompetent perforating veins.

The surgical technic involving high saphenous ligation is well established. The simultaneous excision of incompetent perforating veins is equally important. The fundamental pathologic physiology is the same in each case, for the saphenous vein as it enters the femoral is itself a communicating branch. It is as necessary to prevent the back pressure through incompetent perforators as it is to prevent the back pressure through the incompetent saphenous. While this principle has been recognized, some<sup>3,7,8,9</sup> have believed that satisfactory obliteration of the small incompetent perforators could be obtained by injection alone, either retrograde at the time of saphenous ligation or postoperatively. This has not proved to be true. The perforators are by no means small. Recurrences have appeared despite numerous postoperative injections in which perforators have been disregarded or missed, and have uniformly responded to subsequent ligation of such perforators. Since perforators are found in almost 50 per cent of the cases their adequate treatment cannot be minimized, and a definite plan for their obliteration must be included in any method of varicose vein management. Multiple incisions are no contraindication to their surgical excision. In less than 15 per cent of the cases were three incisions necessary, and in most two were sufficient. This method of combined ligation has in our experience prevented recurrence, shortened the period of treatment and lessened the total number of necessary postoperative injections. The average period of hospitalization has been 13.3 days, a relatively short period for patients who are returned to full duty.

Complications in this series were few. Two patients developed minor pulmonary infarctions following the development of postoperative thrombophlebitis in the operated leg. These were treated with repeated lumbar sympathetic blocks and

the usual supportive measures. There were seven minor wound infections in a total of 456 incisions and these occurred during a period when No. 2 chromic catgut was the only available suture material. There were no deaths.

#### SUMMARY AND CONCLUSIONS

1. Criteria for selection of cases suitable for surgery are presented for Army personnel with varicose veins.

2. Simple diagnostic maneuvers are described.

3. An outline of surgical technic emphasizes simultaneous high saphenous ligation and excision of incompetent perforating veins.

4. The results in 214 operations are given.

5. While the difficulties of follow-up in an Army Station Hospital make a long range evaluation of any series of cases impossible, the treatment outlined provides an adequate, effective, and safe method for the handling of varicose veins.

#### REFERENCES

1. PRATT, G. H. Surgical treatment of varicose veins and ulcers by segmental sclerosis. *Am. J. Surg.*, 44: 31, 1939.
2. TRENDELENBURG, F. Ueber die Unterbindung der Vena Saphena magna bei Unterschenkelvaricen. *Beitr. z. klin. Chir.*, 7: 195, 1891.
3. PRATT, G. H. Segmental sclerosis of the saphenous vein for varicose veins, ulcers, and diminished arterial supply. *J. A. M. A.*, 113: 925, 1939.
4. McCALLIG, J. J. A basic understanding of varicose veins. *J. A. M. A.*, 115: 97, 1940.
5. HOWARD, N. J., JACKSON, C. R. and MAHON, E. J. Recurrence of varicose veins following injection. *Arch. Surg.*, 22: 353, 1931.
6. FREEMAN, NORMAN, E. Physiological principles in the treatment of varicose veins. *Surg. Clin. North America*, 19: 1525, 1939.
7. STALKER, L. K. and HEYERDALE, W. W. Factors in recurrence of varicosities following treatment. *Surg., Gynec. Obst.*, 71: 723, 1940.
8. MAHORNER, A. R. and OCHSNER, A. The modern treatment of varicose veins as indicated by the comparative tourniquet test. *Ann. Surg.* 107: 927, 1938.
9. MOORE, S. W. and KNAPP, G. M. Varicose veins. *Ann. Surg.*, 115: 131, 1942.
10. VAUGHN, A. M. and LEES, W. M. Fatal pulmonary embolism following varicose vein injection. *J. A. M. A.*, 118: 1293, 1942.
11. HARKINS, H. N. and SCHOG, R. Surgical management of varicose veins: importance of individualization in the choice of procedure. *Surgery*, 2: 402, 1942.



# TREATMENT OF BURNS\*

## SYMPOSIUM

HANS MAY, M.D.

PHILADELPHIA, PENNSYLVANIA

THE treatment of burns has undergone significant changes during the past two decades. Up to 1900, the treatment of burns was, more or less, a local treatment. Although laboratory studies were made and the significance of fluid loss and hemoconcentration (Baraduc, Tappeiner) and changes of the morphology of the blood picture (Wertheim, Lesser) were known, these important facts were, as a rule, not followed up therapeutically. It is estimated that two-thirds of the patients who were burned died from shock and infection. In the beginning of our century, the general treatment started to receive more consideration and was under the influence of the toxic theory. According to the latter, toxic substances are released from the burned area, causing shock and toxemia (Bardeen, Wilms, Pfeiffer, Dale and associates, Cannon and Bayliss, Robertson and Boyd). The toxic theory lost importance since Underhill and his associates' systematic investigation of the rôle of fluid loss in burns (1921-1923). Since this time, the treatment of burns has gone through four significant phases. Each phase has added a definite improvement, with a lowering of the mortality rate and the lessening of suffering of the patient.

In 1921, Underhill and his co-workers had the opportunity of treating twenty-one persons seriously burned in a theatre fire in New Haven. At the same time, they made important investigations of fluid loss and blood concentration following burns. Their investigations led them to the conclusion that the clinical picture of toxemia developing in cases of burns is not due to absorption of a toxic substance derived

from burned areas but due to hemoconcentration. The blood capillaries became injured from the heat and became permeable; this results in a rapid pouring out of fluid on the burned surface and into the tissues, causing marked general edema of the affected part. The rapid and continued loss of fluid from the blood in cases of burns quickly induces a marked concentration of the blood. The condition of the patient depends on the amount of the concentration. Underhill considered restoration of blood concentration of prime significance. His systematic treatment of burns consisted simply in the forcing of fluid by mouth, rectum, hypodermoclysis or intravenous infusion. Restoration of normal blood concentration by adequate forcing of fluid was accompanied by marked evidences of improvement and the development of the usual sequels: delirium, unconsciousness, gastrointestinal disturbances, albuminuria, hemoglobinuria, of extensive burns were checked. Underhill and his co-workers later confirmed the clinical findings by animal experiments. They also were able to disprove experimentally any possibility of absorption of toxins from the burned area. Underhill's investigations were a remarkable step forward in the treatment of burns. For the first time, the important fact of fluid loss and hemoconcentration, although known before, was systematically followed therapeutically.

The next important phase in the treatment of burns was the introduction of tannic acid by Davidson in 1925. No other treatment up to that time had reduced suffering of the burned patient and lowered the mortality as much as the tanning

\* Presented before the Philadelphia Academy of Surgery, October 12, 1942.



FIG. 1. A, girl, four years of age with third degree burns treated with triple dye. She received 700 cc. of plasma in 445 cc. of 5 per cent glucose and 6 cc. of eschatine upon admission and during the next twenty-four hours. She received 250 additional cc. of plasma on the second day. Her hematocrit reading was 52 per cent cells on admission and dropped to 48.6 per cent within thirty-six hours. Sulfadiazine was administered and five blood transfusions given, 150 cc. each, within the next three weeks. The eschar started to come off three weeks after admission. The patient now received daily saline tub baths and sulfallantoin solution and saline dressing. The condition of the patient after the eschar came off is pictured in Figure 1B. The first skin grafting operation was performed four weeks after admission (Fig. 1C.) Axilla and surrounding areas were grafted first. Second operation two weeks later, (Fig. 1D.) The third and fourth operation two weeks apart from each other covered all raw surfaces. The patient was discharged four and one-half months after admission. Fig. 1E shows condition of patient six months later.

May—Burns

principle. According to the mortality statistics of the Bureau of Census, there were 8,083 deaths from burns in the United States in 1928, while there were 5,232 in 1933. This decrease has followed the introduction of the tannic acid treatment by Davidson in 1925-1927.\* This treatment was based on the toxic theory. Davidson used tannic acid to precipitate any toxin that may be formed in the burned skin and to prevent it from becoming absorbed. It is a subject of considerable controversy, however, as to whether this theory is true. The present concensus of opinion is that the main benefit of the tanning principle lies in decreasing the loss of fluid from the burned area, relieving pain, preventing infection, and diminishing autolytic changes.



FIG. 1. For descriptive legend see page 35.

\* Editorial, J. A. M. A., May 30, 1942.

The third important phase in the treatment of burns started with the work of Aldrich and Firor (1929-1932). Their theory was that infection is the major cause for the toxemia in cases of burns. These authors were impressed with the fact that, as proved by positive cultures from the burned area and positive blood cultures, there is enough obvious infection present in all large superficial infections to account for all symptoms and physical signs exhibited by the patient. Their conception was that a burn is a large open

surgical lesion bathed in a virulent pus. Aldrich believed that the value of tannic acid lay in the formation of an eschar over a practically sterile burn, and the sealing of the burn which prevented fluid loss and contamination. In looking for an antiseptic substance to combat infection in cases of burns, Aldrich and Firor chose gentian-violet because of the bactericidal and bacteriostatic action of this dye. They also found that it not only was a specific against gram-positive organisms, but also had another beneficial quality: the dye reacted with the burned skin superficially to form a light, tough, flexible eschar. Furthermore, while tannic acid may damage the surviving epithelial islands, gentian-violet did not do it. The action of gentian-violet, however, is weak against the gram-negative organisms; therefore, Aldrich went one step further in devising a mixture of three aniline dyes: crystal-violet, brilliant green, and neutral acriflavine, known as triple dye, which is specific against the gram-positive organisms as well as against the gram-negative ones. Thus, Aldrich's and Firor's work pointed out for the first time the serious complications of infection in cases of burns. Since that time, various other treatments based on the infectious theory were devised, particularly since the dawn of the sulfonamide era. Sulfonamides administered by mouth have become almost a routine treatment in cases of burns. The local application has been advised by Pickrell and others. Pickrell sprays 3 per cent sulfadiazine in 8 per cent triethanolamine, which forms gradually an eschar over the burned area. It takes, however, four days with hourly spraying the first day, every two hours the second day, every three hours the third day, and every four hours the fourth day before an eschar is formed. Gower treats fresh burns with scarlet red bandages and moist sulfanilamide dressings. Cod liver oil as a dressing is also highly recommended by Lohr and others. Hardin, in reviewing the literature on that subject enumerates the following advantages: The oil is sterile and bacteri-

cidal; it is stimulating to granulation and epithelization; it accelerates liquefaction of the dead tissue; it produces a beneficial

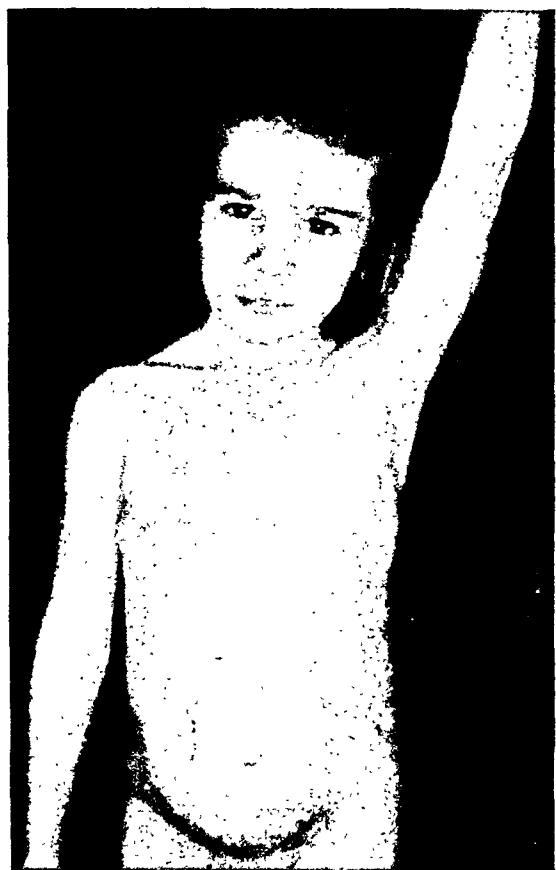


FIG. 1E. For descriptive legend see page 35.

local and systemic response, and it acts also as a protective layer between the lesion and the dressing.

The fourth phase in the treatment of burns started with the introduction of plasma infusions. It was known before Underhill's and his co-worker's investigations that the fluid which escapes from the burned area was not merely water. Tappeiner (1881) pointed out that death from burns is due to hemoconcentration from loss of plasma and he was one of the first to advise the infusion of serous fluids. It was not until much later that his advice was appreciated, mainly through the investigations of Underhill and co-workers, Blalock, McIver, McClure, Harkins, Elman, Scudder, Moon, Lee, Elkinton, Wolff, Rhoads, Black and others. Normally, fluid is kept from leaking through the capillaries by the osmotic pressure of the

plasma proteins against the capillary blood pressure. If, as in burns, the capillaries become injured and permeable plasma

colloidal properties. Whole blood transfusions are recommended less, since they may increase the cellular constituents of



FIG. 2. A, contracture of right axilla from extensive burn. A strip of normal skin is visible between arm and chest. To correct the contracture, the binding scar is incised along the median border of the strip of normal skin; the contracture is reduced and the large defect resulting from reduction is covered with a thick split graft. B, same patient six months after operation.

escapes from the circulation, this results in reduction of the osmotic pressure within the capillaries. If, in such a state aqueous solutions are injected, the plasma proteins become diluted to a concentration that makes it impossible to hold the fluid given intravenously or by other means into the blood stream. In other words, in severe burns the more aqueous solutions are administered, the more fluid is poured out. What is needed is the replacement of the lost plasma. Weiner, Rowlette and Elman were among the first to stress the importance of replacing the lost plasma by plasma infusions, they also recommended the intravenous use of acacia due to its

the blood that already has a high cell concentration. Elkinton, Wolff and Lee state that the capillary permeability with continued loss of plasma in burns lasts from thirty-one to forty hours. During this period, excessive hemoconcentration may be prevented by small repeated plasma transfusions. After the capillaries have regained their impermeability to protein, the deficit of plasma protein may be corrected quantitatively by a large plasma transfusion. The amount of plasma required is calculated by a formula based on hematocrit values, plasma protein concentration and body weight. In order to decrease capillary permeability, or at

least to shorten its duration, the same authors recommend intravenous administration of adrenal cortical extracts, which have been used in the treatment of traumatic shock by Swingle and co-workers, Heuer, Andrus and others. The results of this procedure are, however, questionable. Thus, plasma transfusions have become a life-saving measure in severe cases of burns. As to the method of preparation of plasma, the work of Thompson, Ravdin, Rhoads and Frank; Strumia, Wagner and Monaghan; Scudder; Mahoney; Kingsley and Howland may be consulted.

#### CLASSIFICATION OF BURNS

Thermal burns are usually classified according to penetration.

The first degree burn, *combustio erythematosa*, is characterized by an erythema of the skin from enlargement of the dermal vessels due to paralysis of their nerves.

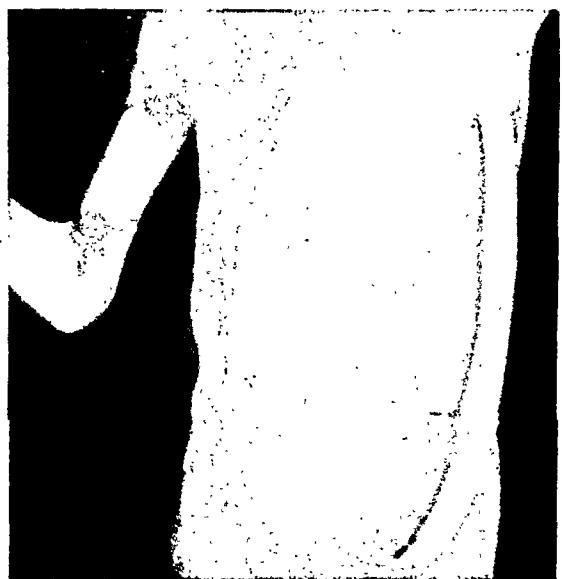
The second degree burn, *combustio bullous*, is characterized by formation of blisters between the epidermis and the corium.

In third degree burns, *combustio escharotica*, the entire epidermis is destroyed. The eschar is hard and insensitive, brownish or black; the vessels are thrombosed, the surrounding parts exhibit burns of first and second degree.

#### CLINICAL PICTURE

The clinical picture of a burn depends mainly upon the extent of the involved area. Minor burns cause only local reaction: extensive burns, however, cause general reaction which may run through the following stages: primary shock, secondary shock, acute toxemia, septic toxemia, healing or death.

**Shock.** Shock, in general, is divided into primary and secondary shock. Primary shock is the collapse which follows the trauma immediately, and is probably due to pain and to various other reflexes and psychological factors; it is usually not of



A



B

FIG. 3. A, contracture of right axilla and elbow joint after third degree burn of right arm, chest, abdomen and back. A tube flap was prepared for correction of the extensive contracture of the elbow joint from the left thoraco-epigastric region (the right side was scarred). B, the flap was transplanted using the left wrist as a carrier. Contracture of right axilla was corrected with "z-operations." Note length of flap on flexor region of elbow joint two years after the operation.

serious consequence. Secondary or traumatic shock is the circulatory collapse that follows one hour after the injury and is characterized by pallor, cyanosis of lips, cheeks, and extremities, cold, moist, sweaty skin, rapid, thready pulse, rapid, shallow respiration, restlessness, nausea, vomiting, falling blood pressure, subnormal temperature, increased hematocrit and leucocytosis. In cases of burns, as in any other traumatic cases, primary and secondary shock may merge imperceptibly into each other.

**Toxemia.** The well known syndrome of toxemia follows extensive burns within the first three or four days, if the patient survives the secondary shock. There is no agreement as to the nature of toxemia. The fact that it can occur or persist after the capillaries have regained their impermeability would exclude hemoconcentration as the sole cause; absorption of toxic substances and infection may also play a rôle. Vomiting is the first evidence of beginning toxemia. It is soon followed by a typical syndrome which is characterized by mental and physical disturbances. The patient becomes restless, complains of thirst and pain, at times is delirious; he is unable to retain food, temperature rises and remains high, and the condition soon assumes a septic character. Pulse and respiration are frequent. The tongue is dry; the blood pressure may remain normal. The leucocytes are markedly increased (25,000 and more). The urine is scanty and concentrated, albumin and acetone may appear. Hemoconcentration with a rapid increase in the hematocrit readings, although present early, may reach its peak at the onset of the toxic stage. Blood chlorides and plasma proteins are reduced, blood sugar and nitrogen elevated. This picture of toxemia may last from one to two weeks. Then, if the patient survives, the patient's mental and most of the physical disturbances clear up. However, there may remain an elevated temperature and pulse, marked leucocytosis, and evidence of secondary anemia and

hypoproteinemia until the greater part of the raw surfaces have healed.

Infection, as already mentioned, is partly responsible for the toxemia syndrome. But, it may recur at a later date, days or weeks after the symptoms of acute toxemia have disappeared. The symptoms and findings of the septic toxemia (Wilson) resemble those of any other surgical septicemia. The prognosis is grave; fatal signs are apathy and semi-consciousness. Blood pressure drops, pulse becomes thready, respiration accelerated and shallow, vomiting, diarrhea, clonicity, coma, collapse, and a marked rise in temperature precede the fatal issue.

#### TREATMENT OF BURNS

*Treatment of Extensive Burns.* The treatment of extensive burns can be divided into an immediate and late treatment. The immediate treatment consists of combatting shock, toxemia and infection. The late treatment consists of covering of the raw surfaces and correction of contractures.

*Immediate Treatment.* Almost every patient with extensive burns exhibits more or less evidence of shock, which must be treated first before proceeding with any local treatment. Everything should be done to combat shock and everything should be avoided that would increase it. Pain is relieved with an injection of morphine. The clothes are removed with the least disturbance to the patient. The burned area is wrapped in sterile sheets. The foot of the stretcher or bed is elevated; the patient is wrapped in warm blankets, heaters, such as hot water bottles, etc., are placed around him. Inhalation of oxygen may be of value. While this is being carried out, the most important measure to combat shock is prepared and administered: restoration of blood volume by continuous intravenous infusion of plasma and 5 per cent dextrose in distilled water. If plasma is not available, transfusion of whole or citrated blood may be substituted, or gum acacia or dextrose alone. Of drugs



A



B

FIG. 4. A, contracture of left axilla. The contracture was due to three bridle scars which were broken up by "z-operations." The "z" of the anterior web has been outlined in Figure 4A. B, six months after operation.

to combat shock, only adrenal cortical extract, known as Eschatin, (5 to 10 cc. injected intravenously every six hours, or Percortin, 2 to 4 cc. injected intramuscularly every four hours) may be of value. Even in those cases which do not exhibit evidence of severe shock, plasma transfusions and administration of adrenal cortical extracts should be given for the purpose of combatting fluid shifting and hemoconcentration. Only if there is evidence that shock is controlled, may local treatment be instituted.

Any burned area must be considered as a surface wound and treated as such. Rigid asepsis must be carried out. The patient is placed on an operating table which is covered with a sterile sheet. The operating room personnel is prepared as for any aseptic operation. After an injection of morphin or under light anesthesia if necessary the cleansing and débridement is done as follows: Oil or grease, if it had been used as a first aid treatment, is removed with ether or benzene. The entire burned area is gently washed with soap and water and rinsed with saline solution. The area is now draped with sterile sheets, all blisters are opened, and the loose, necrotic skin is removed. Then the entire area is flushed with copious amounts of warm normal saline solution and dried, if possible, with a hair dryer. The entire burned area is treated with the "sealing" methods or by open drainage. Since the introduction of plasma infusions to combat fluid loss the "sealing" methods have lost popularity.

*Tannic Acid Treatment.* Tannic acid silver nitrate, as recommended by Bettman, has several advantages as contrasted with tannic acid alone. The main advantage is the fact that coagulation can be accomplished in minutes, while hours are necessary if tannic acid alone is used. A freshly made 5 per cent tannic acid solution is applied with cotton swabs to the burned area. The surface dries quickly. Following this, a 10 per cent silver nitrate solution is applied in the same manner,

causing immediate coagulation. This procedure is repeated until a satisfactory eschar is obtained. After twenty-four hours, freshly formed blisters are opened and treated in the same manner. Tannic acid treatment when correctly carried out according to rules laid down by Davidson himself and such men as Penberthy and McClure, who were closely associated with him, and Bettman, gives good results. Serious arguments have, however, arisen recently against its use, of which the destructive nature of the tannic acid against surviving epithelial islands (Cannon and Cope, Hirschfeld) and the inflexibility of the eschar are the most important ones.

*Triple Dye Method.* The formula of triple dye is crystal violet 1 per cent, brilliant green,  $\frac{1}{2}$  per cent, neutral acriflavine  $\frac{1}{4}$  per cent dissolved in distilled water. The triple dye is sprayed over the dried, burned surface. The eschar is now dried again with a hair dryer, followed by another layer of triple dye, which is dried again. Usually, by that time, a thin, flexible eschar is produced and analgesia is obtained. Any blisters developing later on are treated in the same way.

*Vaseline Gauze and Compression Dressing Method* (Brown, Koch, Mason, Allen, Siler and Reid, Cope, Cannon). With the injured surface cleansed as completely as possible it is smoothly covered with a few layers of fine meshed gauze impregnated with petrolatum. Such gauze is easily prepared in strips three inches wide and twelve inches long and sterilized in a porcelain basin provided with a well fitting cover. This dressing does not adhere to the raw surface as does a coagulant crust; it does not fix tissue and it still permits drainage of serum and exudate into the dressings outside it. Koch's instructions are:

"Over the petrolatum gauze is laid a half dozen layers of flat, dry, sterile gauze, over this a mass of gauze fluff and over the fluff, mechanic's waste or sea sponges so as to provide under the retaining bandage a resilient covering that produces an even

pressure over the injured extremity or the burned surface but does not cause constriction.

"The dressing and compression sponges are held in place preferably with an elastic bandage such as stockinet. This is particularly advantageous if the burn involves the trunk."

Burned limbs are immobilized with splints. This primary dressing is changed after twelve to fifteen days and then at regular intervals of twenty-four or forty-eight hours with removal of any adherent tissue that can be cut away without causing pain or bleeding. This treatment pursues the same purpose as the tanning principle: covering a large, open wound which has been changed from a contaminated to a clean wound with an occlusive dressing to check the danger of infection; secondly, checking consistent loss of serum from the burned area and into the tissue by pressure dressings.

The advantage of this treatment as contrasted with the tanning principle lies in its quicker and simpler application, open drainage and quicker preparation of the area for skin grafting.

After the application of the local treatment, the patient is placed under a thermo-regulated heat cradle; the intravenous infusion is kept running at a speed of about 40 to 60 drops per minute. Hemoconcentration and plasma protein levels are determined every six hours. The amount of plasma administered intravenously depends upon the degree of the hemoconcentration. The desired amount is calculated according to formulas, such as recommended by Lee and his co-workers, (Wolff, Elkinton, Rhoads), who based the treatment of burn shock upon a quantitative basis. This formula takes the body weight, the plasma protein level and the hematocrit level into account. A simple but not as accurate method of calculating plasma dosage in burns was devised by Harkins: Give 100 cc. of plasma for every point the hematocrit is above the normal of 45. This formula does not take the exist-

ing plasma protein level into account. Plasma is administered until the hematocrit value remains around 50 per cent cells and the plasma protein level around 6 Gm. per cent. When laboratory facilities are not available, the amount of plasma to be given is calculated according to the extent of the burned body surface (Harkins). According to Berkow's evaluation of surface area of the body, the percentage of the burned area is estimated—head-neck 6 per cent, upper extremities 18 per cent, trunk 38 per cent, lower extremities 58 per cent—and 50 cc. of plasma should be given for every per cent of the body surface affected by a deep burn. The formula roughly estimates the entire amount of plasma that will be necessary; one-third of this amount should be administered during the first two hours; one-third the next four hours, and one-third the next six hours.

Sulfanilamide orally or intravenously administered is strongly recommended; the oral administration may be impossible due to vomiting.

Further treatment consists of improving the patient's general condition and if the tanning principle has been used careful watching of the eschar for any evidence of infection. If tannic acid is used, it may be difficult to locate the infected area. Drilling of the eschar in various places may be necessary. If the infected area is found, the eschar must be dissected away. If triple dye is used, the eschar becomes soft and moist over the infected area and can easily be removed with scissors.

If no infection intervenes, the eschar is allowed to stay until it comes off by itself. In second degree burns, the coagulum peels off in several weeks, leaving an epithelialized red, dry, skin surface beneath. This process may be speeded up by application of compresses soaked in hypertonic saline solutions. Hypotonic saline solutions are not recommended, since they may lead to absorption of autolytic material and toxic symptoms. In third degree burns, the coagulum peels off in some places, leaving

a granulating surface behind, and remains in other places. The remaining eschar is covered with hypertonic solution. Daily baths in hypertonic solution are recommended. If the open drainage principle is used, the sloughing areas are débrided on changing each dressing.

*Late Treatment.* Whenever indicated, skin grafting should be done as soon as possible. If a granulating surface is left—as in every third degree burn—it should be skin grafted. The quicker epithelialization is brought about, the less will be the degree of contracture. Brown and McDowell, in a recent monograph, give an excellent description of the healing process of the burned surface. However, it must be remembered that skin grafts will take only on pinkish, flat, healthy looking granulations. If the granulating area is chronically infected and the granulations are sluggish, hypertrophic, and gray, the healing process should be stimulated by general and local measures before skin grafting can be successful. Frequent blood transfusions until the hemoglobin is well above 55 per cent, administration of vitamins and iron in a high caloric diet are paramount. Daily saline baths, exposure to sunlight or ultraviolet rays stimulate not only the local but also the general condition. The granulating area may be treated with local application of sulfonamide drugs (not more than 15 Gm. daily), together with wet dressings such as hypertonic saline solutions, Dakin's solution, or sulfallantoin, (Koerber and associates and others). I found the latter solution particularly valuable in hastening liquefaction of dead tissue and stimulating the growth of healthy granulations. Or ointments may be used such as cod liver oil ointments, scarlet red, etc. Application of zinc peroxide has been recommended for those granulations which tend to bleed (Altemeier and Carter). Most important is the application of a pressure dressing to counteract edema and to prevent the granulations from becoming edematous. If, in spite of all measurements, the granulations remain

edematous and boggy, skin grafting should be started nevertheless. The host area should be sprinkled with sulfanilamide, which does not interfere with the "take" of the graft (Converse). If, in spite of these precautions the grafts do not take, thin split grafts about the size of a thumbnail—so-called "island grafts"—should be used, or seed grafting may be attempted. However, if granulations are pinkish and healthy, the transplantation of a large, thick, split graft is the preferred type. Those regions which tend to contract, such as the flexor surfaces of the extremities or the junctions of limbs and trunk should be covered first. A several-stage procedure may be necessary; the same donor areas may be used several times. As many as four times, grafts have been taken from the same area. If contractures have already developed, they should be corrected as soon as possible (May).

*Treatment of Extensive Burns of Face, Hands, Feet, Perineum and Genitalia.* These areas deserve special consideration. No coagulant should be used for burns in these regions; a coagulant on the fact, particularly around the eyes and mouth, is uncomfortable for the patient; at hands and feet it may constrict circulation, and at the perineum and genitalia, it harbors infection. After thorough débridement, the burned surfaces are covered with an ointment such as sulfanilamide ointment in combination with cod liver oil or Foille, which due to its analgesic effects is recommendable, (Hamilton, C. B. Owings, Personal Communication) or boric ointment. The face is then covered with fine meshed gauze. Deep burns of the eyelids tend to contract the eyelids and to evert them, causing an ectropion; suturing the eyelids together may counteract contraction.

The fingers and toes are best treated individually to prevent adhesions. Each finger is wrapped in fine meshed gauze in which the ointment is incorporated. The entire hand is then wrapped in surgical gauze; the hand, including the arm, is

placed on a padded splint and immobilized; the splint is kept elevated. The dressings are changed every two days. They are soaked off in saline baths. In third degree burns, early skin grafting is necessary.

Perineum and genitalia may be treated with ointment and covered with mesh gauze. The vulva, however, and anal regions are best treated with gauze soaked in antiseptic solution such as merthiolate and others. Frequent changings are necessary to prevent infection and avoid adherence of the gauze to the burned area.

*Treatment of Minor Burns.* Minor burns may be called burns of less than 5 to 10 per cent body surface. In most instances, they can be treated ambulatory, unless the location of the burned area is such as to require hospitalization. They usually do not require any general treatment, but the relief of pain by administration of a sedative. In first degree burns, application of antiseptic and analgesic ointments, such as Foille, or butesine picrate is recommended. The latter is an excellent analgesic, but should be used with caution, i.e., not repeatedly, since it may cause toxic symptoms. Second and third degree burns require débridement and the application either of an antiseptic analgesic ointment, or application of a coagulant. If the latter is used, triple dye is preferred for the flexible properties of its eschar. The burned area should be protected with sterile dressings; application of splints may be necessary; ultimate treatment does not differ from that of extensive burns.

#### REFERENCES

- ALDRICH, R. H. The role of infection with special references to gentian violet. *New England J. Med.*, 208: 299, 1933. Treatment of burns with a compound of aniline dyes. *Maine M. J.* 28: 5, 1937. A critical survey of the treatment of burns. *Maine M. J.*, 33: 21, 1942.
- ALLEN, H. S. and KOCH, S. L. The treatment of patients with severe burns. *Surg., Gynec. & Obst.*, 74: 914, 1942.
- ALTEMEIER, W. A. and CARTER, B. N. Infected burns with hemorrhage. *Ann. Surg.*, 115: 1118, 1942.
- BARADUC, H. Des causes de la mort à la suite des brûlures superficielles des moyens de l'éviter, Paris, 1862.
- BARDEEN, C. R. A review of the pathology of superficial burns, with a contribution to our knowledge of the pathological changes in the organs in cases of rapidly fatal burns. *Johns Hopkins Hosp. Rep.*, 7: 137, 1898.
- BEARD, J. W. and BLALOCK, A. Experimental shock: composition of fluid that escapes from bloodstream after mild trauma to extremity, after trauma to intestines and after burns. *Arch. Surg.*, 22: 617, 1931.
- BERKOW, S. G. A method of estimating the extensiveness of lesions (burns and scalds), based on surface area proportions. *Arch. Surg.*, 8: 138, 1924.
- BETTMAN, A. G. Tannic acid—silver nitrate in burns. *Surg., Gynec. & Obst.*, 62: 458, 1936. The rationale of the tannic acid-silver nitrate treatment in burns. *J. A. M. A.*, 108: 1490, 1937.
- BLACK, A. K. Treatment of burn shock with plasma and serum. *Brit. M. J.*, 2: 693, 1940.
- BLALOCK, A. and MASON, M. F. *Principles of Surgical Care: Shock and Other Problems*. St. Louis, 1940. C. V. Mosby Co. Blood and blood substitutes in the treatment and prevention of shock: with particular reference to their use in wartime. *Ann. Surg.*, 113: 657, 1941.
- BROWN, J. B. and McDOWELL, F. *Skin Grafting of Burns*. Philadelphia, 1943. J. B. Lippincott Co.
- BUNYAN, J. The treatment of burns and wounds by the envelope method. *Brit. M. J.*, 2: 1, 1941.
- CANNON, B. Procedure in rehabilitation of the severely burned. *Ann. Surg.*, 6: 903, 1943.
- CANNON, B. and COPE, O. Rate of epithelial regeneration. A clinical method of measurement and the effect of various agents recommended in the treatment of burns. *Ann. Surg.*, 1: 85, 1943.
- CANNON, W. B. *Traumatic Shock*. New York, 1923. D. Appleton Co.
- COLEBROOK, L. The local application of sulphonamide powder. *Brit. M. J.*, 2: 680, 1940.
- CONVERSE, J. M. Early skin grafting in war wounds of extremities. *Ann. Surg.*, 115: 321, 1942.
- COPE, O. The treatment of surface burns. *Ann. Surg.*, 6: 885, 1943.
- DALE, H. H. and RICHARDS, A. N. The vasodilator action of histamine and of some other substance. *J. Physiol.*, 52: 110, 1918.
- DALE, H. H. and LAIDLAW, P. P. Histamine shock. *J. Physiol.*, 52: 355, 1919.
- DAVIDSON, E. C. Tannic acid in the treatment of burns. *Surg., Gynec. & Obst.*, 41: 202, 1925. The prevention of toxemia of burns, treatment by tannic acid solution. *Am. J. Surg.*, 40: 114, 1926.
- ELKINTON, J. R., WOLF, W. A. and LEE, W. E. Plasma transfusion in the treatment of the fluid shift in severe burns. *Ann. Surg.*, 112: 150, 1940.
- ELMAN, R. The therapeutic significance of plasma protein replacement in severe burns. *J. A. M. A.*, 116: 213, 1941.
- GOWER, W. E. Treatment of fresh burns with scarlet red bandage and moist sulfanilamide dressings. *J. Iowa M. Soc.*, 31: 234, 1941.
- GURD, F. B., ACKMAN, D., GERRIE, J. W. and PRITCHARD, J. E. A practical concept for the treatment of major and minor burns. *Ann. Surg.*, 116: 641, 1942.
- HAMILTON, J. E. A comparative study of local burn treatments. *Am. J. Surg.*, 58: 350, 1942.

- HARDIN, R. C. Cod liver oil therapy of wounds and burns. *South. Surgeon*, 10: 301, 1941.
- HARKINS, H. W. Recent advances in the study and management of traumatic shock. *Surgery*, 9: 231, 447, 607, 1941. *The Treatment of Burns*. Springfield, Ill., 1942. Charles C. Thomas. The treatment of burns in war time. *J. A. M. A.*, 119: 385, 1942. The local treatment of thermal burns. *Ann. Surg.*, 115: 1140, 1942.
- HEUER, G. J. and ANDRUS, W. D. The effect of adrenal cortical extract in controlling shock following the injection of aqueous extracts of closed intestinal loops. *Am. Surg.*, 100: 734, 1934.
- HIRSCHFELD, J. W. A comparison of the effects of tanning agents and of vaseline gauze on fresh wounds of man. *Surg., Gynec. & Obst.*, 76: 556, 1943.
- KOERBER, K. A., SPANGLER, H. A., O'DONNELL, C. and MOFFSER, G. H. Sulfallantoin in industrial medicine. *Indust. Med.*, Oct. 1942.
- LEE, W. E., ELKINTON, J. R. and WOLFF, W. A. The management of shock and toxemia in severe burns. *Pennsylania M. J.*, 44: 1114, 1941.
- LEE, W. E., WOLFF, W. A., SALTONSTALL, H. and RHOADS, J. E. Recent trends in the therapy of burns. *Ann. Surg.*, 115: 1131, 1942.
- LESSER, L. Über die Todesursachen Nach Verbrennungen. *Virchows Arch. f. path. Anat.*, 79: 248, 1880.
- LÖHR, W. Die Behandlung grosser, flächenhafter Verbrennungen 1, 2, and 3. Grades mit Lebertran. *Cbirurg.*, 6: 263, 1934. Behandlung von Brandwunden mit Lebertran Salbe. *Arch. f. klin. Cbir.*, 195: 203, 1939.
- LUSTGARTEN, S. Zur Theory der Primären Todesursache bei Verbrennungen. *Wien. klin. Wchnscbr.*, 4: 528, 1891.
- MAHONEY, E. B., KINGSLEY, H. D. and HOWLAND, J. W. The therapeutic value of preserved blood plasma. *Ann. Surg.*, 113: 969, 1941.
- MASON, M. L. Local treatment of the burned area. *Surg., Gynec. & Obst.*, 72: 250, 1941.
- MAY, H. The correction of scars. *Am. J. Surg.*, 50: 754, 1940.
- MCCLURE, R. D. The treatment of the patient with severe burns. *J. A. M. A.*, 113: 1808, 1939.
- MINOT, A. S. and BLALOCK, A. Plasma loss in severe dehydration, shock and other conditions as affected by therapy. *Ann. Surg.*, 112: 557, 1940.
- MOON, V. H. Shock and Related Capillary Phenomena. New York, 1938. Oxford University Press.
- PACK, G. T. and DAVIS, A. H. Burns: Types, Pathology, Management. Philadelphia, 1930. J. B. Lippincott Co.
- PENBERTHY, G. C. and WELLER, C. N. Treatment of burns. *Am. J. Surg.*, 46: 468, 1939. Treatment of burns. *Surg., Gynec. & Obst.*, 74: 428, 1942.
- PFEIFFER, H. Experimentelle Beiträge zur Aetiologie des Primären Verbrennungstodes. *Virchows Arch. f. path. Anat.*, 180: 367, 1905.
- PICKRELL, K. L. A new treatment for Burns—preliminary report. *Bull. Johns Hopkins Hosp.*, 69: 217, 1941.
- RHOADS, J. E., WOLFF, W. A. and LEE, W. E. The use of adrenal cortical extract in the treatment of traumatic shock of burns. *Ann. Surg.*, 113: 955, 1941.
- ROBERTSON, B. and BOYD, G. L. Toxemia of severe superficial burns. *J. Lab. & Clin. Med.*, 9: 1, 1923.
- SCUDDER, J. Shock: Blood Studies as a Guide to Therapy. Philadelphia, 1940. J. B. Lippincott Co.
- SILER, V. E. and REID, M. R. Clinical and experimental studies with the Koch method of treatment of heat burns. *Ann. Surg.*, 115: 1106, 1942.
- SPIETSCHKA, T. Über Verbrennungen und Verbränningstod. *Arch. f. Dermat. u. Syph.*, 103: 41, 1910.
- STRUMIA, M. M., WAGNER, J. A. and MONAGHAN, J. F. The intravenous use of serum and plasma, fresh and preserved. *Ann. Surg.*, 111: 623, 1940.
- SWINGLE, W. W., PARKINS, W. M., TAYLOR, A. R. and HAYS, H. W. A study of the circulatory failure of adrenal insufficiency and analogous shock-like conditions. *Am. J. Physiol.*, 123: 659, 1938.
- TAPPEINER. Über Veränderungen des Blutes und der Muskeln nach ausgedehnten Hautverbrennungen. *Centralbl. f. d. med. Wiss.*, 19: 385, 401, 1881.
- THOMPSON, W. D., RAVIN, I. S., RHOADS, J. E. and FRANK, I. L. Use of lyophile plasma in correction of hypoproteinemia and prevention of wound disruption. *Arch. Surg.*, 36: 509, 1938.
- UNDERHILL, F. P., Changes in blood concentration with special reference to the treatment of external superficial burns. *Ann. Surg.*, 86: 840, 1927.
- UNDERHILL, F. P., CARRINGTON, G. L., KAPSINOW, R. and PACK, G. T. Blood concentration changes in extensive superficial burns, and their significance for systemic treatment. *Arch. Int. Med.*, 32: 31, 1923.
- UNDERHILL, F. P., KAPSINOW, R. and FISK, M. E. Studies on the mechanism of water exchange in the animal organism. *Am. J. Physiol.*, 95: 302, 315, 325, 334, 339, 1930.
- UNDERHILL, F. P. and FISK, M. E. Studies on the mechanism of water exchange in the animal organisms. *Am. J. Physiol.*, 95: 330, 348, 364, 1930.
- WERTHEIM, G. *Wien. med. Presse*, 8: 1237, 1867; *Wien. med. Wchnscbr.*, 18: 826, 1868.
- WILMS, M. Studien zur Pathology der Verbrennungen. Die Ursache des Todes nach ausgedehnter Hautverbrennung. *Mitt. a. d. Grenzgeb. d. Med. u. Cbir.*, 8: 393, 1901.
- WILSON, W. C., MACGREGOR, A. R. and STEWART, C. P. The clinical course and pathology of burns and scalds under modern methods of treatment. *Brit. J. Surg.*, 25: 826, 1938.
- WOLFF, W. A., ELKINTON, J. R. and RHOADS, J. E. Liver damage and dextrose tolerance in severe burns. *Ann. Surg.*, 112: 158, 1940.
- WOLFF, W. A. and LEE, W. E. A simple method for estimating plasma protein deficit after severe burns. *Ann. Surg.*, 115: 1125, 1942.



# SKIN AS A SOURCE OF SYSTEMIC INFECTION

I. W. HELD, M.D.

Attending Physician, Beth Israel Hospital

AND

IRVING BUSCH, M.D.

Associate Surgeon, Beth Israel Hospital

NEW YORK, NEW YORK

**S**EPSIS signifies that bacteria enter the blood stream, form a focus in the body and give rise to local and systemic symptoms (Schottmueller). For the successful treatment of sepsis the location of the primary focus is of the utmost importance. In this communication the skin as a primary focus of systemic infection will be discussed.

Since the advent of sulfachemotherapy, the mortality in cases of sepsis has been immensely reduced. Chemotherapy, however, does not eliminate the necessity of locating the primary focus because in many instances the removal of the primary focus is actually life-saving and necessitates a minimum of chemotherapeutic application. In other instances the eradication of the primary focus prevents the establishment of a secondary focus which either immediately or remotely, may cause serious sequelae.

In order that the skin may serve as a portal of entry, there must be an interruption in its continuity. The skin, particularly the exposed parts, is subject to injury, which frequently occurs among workers who handle sharp tools in such occupations as meat-cutting, skinning, stone-cutting. Ordinary skin conditions such as acne vulgaris, dermatophytosis or impetigo, may occasionally harbor virulent bacteria, which in turn may enter the blood stream and cause sepsis.

It is rather remarkable that a small furuncle or carbuncle may completely heal and leave in its trail bacteria in some distant tissue of the body, which later may constitute a secondary focus of infection.

One may wonder why the skin is not the cause of general sepsis more frequently.

The outstanding reason is the strong specific tissue immunity of the skin. This has been demonstrated by innumerable experiments. Clinical appreciation of this fact is substantiated by the following observations. Most infectious and contagious diseases characterized by exanthema endow the afflicted individual with permanent immunity. Thus, in scarlet fever, measles, small pox, typhoid and typhus, there is no recurrence after recovery. On the other hand, in infectious or contagious diseases without skin manifestations, such as diphtheria or pneumonia, recurrences are not rare. Cases of syphilis without exanthema of the skin in the secondary stage are more likely to develop tertiary cerebrospinal or vascular involvement, which explains the unawareness of a primary syphilitic infection in many patients who present themselves with cerebrospinal or vascular lues. The physician usually states that the patient denied lues. The patient is actually ignorant of the fact that he had a primary infection because he failed to show any skin manifestations which might have caused him to seek treatment, and thereby prevent the hazardous tertiary incurable lesions. Further evidence of the importance of the skin in serving as a protective mechanism against infection, are the local Schwartzmann phenomenon, and the fact that both sensitization and desensitization of disease are exercised through the medium of the skin.

However, local tissue immunity may at times be unable to resist the extraordinary virulence of the invading organism, so that a small interruption of continuity of the skin may be followed by serious systemic infection almost immediately.

There are two groups of bacteria which cause systemic infection. The septicemia group is caused most often by staphylococci, less often by streptococci, and occasionally by the gas gangrene group of organisms. The toxin producing organisms are represented mainly by *Clostridium tetanus* and occasionally *Bacillus anthrax*.

#### STAPHYLOCOCCIC SEPSIS

Staphylococcic sepsis, according to clinical manifestations, may be divided into five groups:

1. *Slight or No Visible Injury of Skin with Fulminating Fatal Sepsis. A Reactive Type.* The patient has severe chills, hyperpyrexia, and even delirium, very frequently positive blood culture of *Staphylococcus aureus hemolyticus*. Most often leucopenia and a marked shift to the left is present. Not infrequently immature white cells and large numbers of myelocytes are found in such abundance as to make it impossible to differentiate it from aleukemic leukemia, except by a study of the bone marrow. The tongue is dry and parched. Death often follows in forty-eight hours. The physical examination is almost entirely negative. Postmortem examination shows cloudy swelling of the liver, heart and kidneys, and most of the capillaries are filled with thrombi. This form of sepsis has been termed cryptogenetic because the focus of infection cannot be located. It is due to the fact that there was complete lack of immunity.

2. *Demonstrable Local Lesion, Removal of Local Lesion Preventing Fatal Sepsis.* This can best be illustrated by the following case:

A girl of nineteen suddenly developed chills and very high temperature (in the era preceding the use of sulfa drugs). On examination, the only evidence of infection was a slight discoloration of the little finger. Roentgen examination of the phalanges was negative. However, because of the local infection and violence of systemic symptoms, amputation of the terminal phalanx was deemed essential.

At operation an infected thrombus was found in the vein which was ligated. Postoperatively, for one or two hours, the patient had chills and marked elevation of temperature. For two days, blood cultures showed a number of colonies of *Staphylococcus aureus hemolyticus*. On the third day, the temperature subsided, and within four or five days after operation the patient recovered.

Certain areas of the skin, namely, neck, lips, nose and eyelids, when infected give rise to sepsis more often than other parts of the body. This is due to the fact that in these regions more direct communications with the veins exist such as the maxillary veins, the occipital and ophthalmic veins and the cavernous sinuses. When an infected thrombus lodges in one of these veins, severe systemic symptoms will result, frequently with fatal termination. However, in this era of effective chemotherapy with sulfa drugs or with the promising penicillin and gramacidin, those lesions inaccessible to surgical intervention may be remedied.

3. *Local Focus of Skin with Minimal Local Symptoms Causing Invasion of Lungs.* *Staphylococcus aureus septicemia* may manifest itself as a systemic infection with multiple metastatic purulent foci, although the primary focus is not discernible.

Such a case was that of a physician, age forty-five years, who complained of pain in the throat, with high temperature but no throat exudate. On the second day he developed diffuse abdominal pain. Physical examination revealed marked tenderness over McBurney's point, but no rigidity or rebound tenderness. The leucocyte count was high, with 85 per cent polymorphonuclears. It was suspected that the patient had an acute appendicitis, and he was removed to the hospital. However, operation was delayed because of the absence of rigidity and muscle spasm, and the high temperature. After twelve hours there were definite signs of pneumonia over the right base. Blood culture showed, within twenty-four hours, a large number of colonies of *Staphylococcus aureus hemolyticus*. The diagnosis was evidently staphylococccemia with a metastatic focus in the lungs, and was later confirmed by

the expectoration of large quantities of pus containing *Staphylococcus aureus*, and by the presence in the chest of encapsulated areas of cloudy effusion. The aspirated fluid likewise contained *Staphylococcus aureus*. The entire course of the disease, which was three months, was characterized by continuous high temperature and severe thoracic pain. Improvement was gradual and eventual recovery complete. Treatment was symptomatic, aspiration of the purulent fluid and numerous blood transfusions, since sulfachemotherapy was not yet known. It was subsequently disclosed that several weeks before the acute illness, he had an infection of the toe with moderate lymphangitis of the leg and swollen glands in the groin.

**4. Secondary Invasion of Endocardium.** Secondary invasion of the endocardium is one of the most serious complications of staphylococcal infection of the skin. If the septic endocarditis is acute, fatal termination occurs within five days, at most within two weeks. In cases in which the staphylococcal endocarditis is subacute, the condition is likewise fatal, but the patient may linger for eight to ten months before succumbing. In all cases of subacute endocarditis there must have been a previously diseased valve.

An illustrative case is that of a young man in the midtwenties, who had a chronic rheumatic valvular lesion and diffuse eczema of the skin. When admitted to Beth Isreal Hospital, he had moderate elevation of temperature, slight anemia, no enlargement of the spleen and no petechiae. Because of the skin lesions subacute bacterial endocarditis was suspected. After several blood cultures, a few colonies of *Staphylococcus albus* were recovered,—a finding thought to be due to contamination. With the administration of sulfathiazole because of persistently elevated temperature, the blood culture became negative. Three weeks later, when the temperature was normal and the blood cultures had been continuously negative, the patient was about to be discharged from the hospital under the impression that the sulfathiazole had had a curative effect, or that the staphylococcus had actually been a contaminant. Two days prior to the supposed date of discharge, blood culture was again repeated, and a large number of *Staphylococcus*

*aureus hemolyticus* colonies were recovered. Despite the continued use of sulfathiazole the patient developed multiple petechiae, embolic manifestations of the spleen, and succumbed two months later. Autopsy was not obtained.

Another example of metastatic foci arising from a non-discernible primary focus, is that of a physician, aged thirty-eight years, who developed chills, high temperature and vague abdominal pains, cough without expectoration, and physical signs of bronchopneumonia. *Staphylococcus aureus hemolyticus* was found on blood culture. At the end of four weeks he developed staphylococcal endocarditis, and succumbed a few days later. Postmortem examination showed multiple abscesses of the lungs, kidney, brain and heart, with ulceration of the mitral valve. The primary focus could not be determined.

In most cases of this type it is reasonable to assume that some minor skin infection, such as dermatophytosis, can be the initial lesion responsible for the virulent infection. We have encountered one case with the primary focus of infection in the external meatus of the ear, and another in the peri-anal region.

**5. Sepsis from a Reactivated Dormant Focus.** The bacteria enter the blood stream from the primary focus in the skin and are deposited in some distant part of the body where they may give rise to infection, constituting a secondary focus. The most common examples are staphylococcal carbuncle of the kidney, and para- or perinephritic suppuration occurring weeks or months after a minor staphylococcal infection of the skin. The *staphylococcus* has a specific predilection for the cortex of the kidney; the more severe the septic infection, the greater the renal damage. Hence multiple miliary abscesses of the kidney are usually found which are the immediate responsible factors for fatal termination. If the staphylococcal infection of the skin is mild in its local expression, only superficial lesions of the kidney may result, constituting a locus minoris resistancie ready to flare up when the individual is debilitated. It should be emphasized that whenever a patient develops chills

and elevation of temperature plus moderate anemia, vague abdominal symptoms and tenderness over a loin, even to a slight degree, thought should be given to the possibility of a carbuncle of the kidney resulting from a hematogenous infection where the primary source has been a minor skin lesion. X-ray examination may aid in the differential diagnosis. Through the independent studies of the late Edwin Beer,<sup>1</sup> and of Lipsett,<sup>2</sup> flat films of the abdomen with special attention to the region of the kidney may give significant early information. Both authors found in peri- and paranephritic infection, obliteration of the psoas muscle and scoliosis of the spine with the concavity toward the affected side. However, we have encountered two cases in whom these x-ray signs were conspicuously absent, causing undue delay in surgical intervention. Such experiences must be borne in mind. In peri- or paranephritic infection and carbuncle of the kidney, the blood culture is almost invariably negative.

There is a group of cases occurring in children or young adults in which the staphylococcus has gained entrance through the skin and the organism deposited in the bones. The bacteria have remained dormant until trauma, even of a minor degree, serves as an exciting cause in producing osteomyelitis. Such patients may have an onset with severe systemic symptoms, chills, high fever, delirium, and local signs of tenderness only on deep pressure. At this time x-rays are entirely negative. Within twenty-four hours, the local swelling increases markedly and the pain becomes excruciating in character.

Because we are fortunate to have the use of sulfa drugs, active chemotherapy should be instituted even before local signs make the diagnosis obvious.

In these cases, blood cultures are invariably positive. Of great clinical importance is the presence of staphylococcal cervical osteomyelitis of one or more vertebrae from the third cervical, down. A minor exciting cause may activate the

dormant bacteria and give rise to symptoms. The onset is sudden, with high temperature, chills, severe occipital headaches radiating down the spine. There is marked local tenderness over the cervical vertebrae. This condition is erroneously diagnosed as meningitis. However, lumbar puncture is always negative. X-ray examination does not as a rule reveal the lesion. But if the clinical picture is borne in mind early surgical intervention is the only means of saving life. A delay of a few days will result in fatal perimeningeal abscess, or invasion of the cervical cord, with resulting bulbar death.

#### STREPTOCOCCIC INFECTIONS

Streptococcic infection originating in the skin is rare. It is usually secondary to a primary focus in a mucous membrane, or in a viscus. However, in cases of streptococcic infection originating in an interruption in the continuity of the skin, the local reaction is sufficiently violent to cause severe local infection and suppuration, so that systemic invasion can be checked by proper treatment.

Several years ago we saw a case at the Beth Israel Hospital, of a twenty-seven year old woman who was admitted with evidence of septicemia, *Streptococcus hemolyticus* having been recovered in the blood culture. The primary focus was an infection around the umbilicus. The patient was not mentally fit to give a history of the origin of the infection, but it is most likely that the streptococci entered the blood stream through this primary infection. Postmortem showed streptococcic endocarditis and miliary abscesses of the heart and kidneys.

Streptococcic skin infections can give rise to rapidly progressive septicemia from an infected hair follicle of the skin. Also, streptococcic furuncles or carbuncles especially on the neck, may be a primary focus for septicemia. A common source of streptococcic sepsis through the skin is seen after punctured wounds acquired during surgical operations by the surgeon, and by the pathologist when performing

an autopsy. Such infections may give rise to severe local reaction, and sometimes to multiple abscesses of the kidney, myocardium and septic endocarditis. In streptococcic skin infections it is not uncommon for multiple metastatic abscesses to occur in the muscles of the abdomen, gluteal muscles or gastrocnemius. In contradistinction to staphylococcic sepsis, lung abscesses are extremely rare in streptococcic sepsis.

*Treatment.* With the advent of the present chemotherapy, the prognosis in the non-fatal cases of sepsis has become very much better. It may be roughly stated that both in staphylococcic and streptococcic sepsis, the mortality has dropped from 65 to 100 per cent, to between 8 and 10 per cent.

There must be early and vigorous administration of the sulfa drugs. The initial dose, if the patient does not vomit, should be 2 to 3 Gm. orally and the same dose to be repeated in four hours. This should be followed by 1 Gm. every four hours, daily, until four days after the symptoms have abated. The usual precautions should be taken of examination of the blood and the urine. Crystal formation in the kidneys can be minimized by the intake of alkalies and large draughts of water.

Most observers have found that sulfathiazole acts best bacteriostatically on the staphylococcus, whereas sulfapyridine, sulfanilimide and sulfadiazine act best on the streptococci. If the patient does not respond sufficiently to the particular sulfa drug that is being given within a period of twenty-four hours, the drug should be replaced by one of the other sulfa preparations.

Sometimes, where we desire a fast high blood concentration, or if there is vomiting, intravenous administration of the sodium salts of sulfathiazole or sulfadiazine should be given.

Despite the efficacy of sulfa therapy, a suppurating focus, if accessible, must be surgically eradicated.

In severe cases it is necessary to main-

tain the fluid and electrolytic balance by intravenous administration of saline and glucose. Blood transfusions should be given when indicated.

Sera, vaccines, toxoids and bacteriophage, which at best were of very doubtful value, are at present in the background since the use of sulfa drugs.

Particularly for staphylococcic sepsis, penicillin promises to be a useful drug.

#### TETANUS

Because of the war, this disease must be discussed in greater detail. Tetanus is caused by a spore-forming anaerobic organism introduced into traumatized skin. It has been experimentally demonstrated that tetanus spores injected in tissues under aseptic conditions do not grow. Recent experiences in the present conflict have shown slight wounds, that were directly covered with gray wool for padding purposes, in some instances became infected with tetanus. Other sources of infection have been contaminated catgut and intramuscular injections. As is well known, tetanus organisms are present in the soil, and a common inhabitant of the intestines of domestic animals, particularly horses.

One of the most commonly accepted theories today is that tetanus toxin is fixed by the central nervous system tissues. This fixed toxin then becomes altered, and the altered toxin causes death by respiratory paralysis. It is, therefore, necessary to institute treatment before a lethal dose of the toxin becomes fixed by the tissues of the central nervous system. From this it follows that with the detection of the earliest possible sign of the disease, treatment must be vigorously instituted.

The most common early symptom is trismus with pain in the angle of the jaw and muscles of the neck. This progresses to the familiar facial expression known as risus sardonicus. Within twenty-four hours in the severe cases, and in the milder cases between forty-eight hours and four to five days, reflex spasms set in. This consists of

a sudden spasm of the jaws and trunk, into tonic contraction. The back and chest become arched (opisthotonus), or the trunk may be bent forward (emprosthotonus), or laterally (pleurosthotonus). The patient may die in one of these reflex spasms due to respiratory failure. In severe cases, death usually occurs within five days. Survival beyond this is in favor of recovery. Those who recover are rarely left with sequelae.

*Treatment.* When the diagnosis has been established, 50,000 units of antitetanic serum should be immediately injected intravenously. It is Firor's<sup>3</sup> contention that this amount can adequately counteract any sublethal dose of tetanus toxin. If a lethal dose is present, any treatment is useless. Since the symptoms in a patient can be just as severe with a sublethal as well as a lethal dose, it is not justifiable to withhold prompt and adequate treatment.

At the time of the intravenous injection, the area about the infection should be injected with 10,000 units of antitetanic serum, in preparation for wide excision of the wound. One should wait an hour before operative treatment, so that the area around the wound is sufficiently saturated to neutralize the toxins in the operative area.

Fifteen thousand to 20,000 units of serum can be given intrathecally or intracisternally. This route has been objected to recently because of experimental observations. It has been shown that the introduction of serum into these areas does not directly neutralize the toxins in the tissues of the central nervous system. The only route to these tissues is through the choroid plexus which can be reached only through the blood stream. The more direct route, therefore, would be the introduction of antitetanic serum intravenously. In addition, the intrathecal or intracisternal administration of serum may cause serious meningitis that may aggravate the symptoms.

For the control of reflex spasms 5 Gm.

of chloral hydrate per rectum may be used. Paraldyhyde 10 cc. to 40 cc. every three hours may be tried. Avertin has been found efficacious in dosage of 60 to 80 mg. per kilo of body weight. This controls the spasms for about six hours. It may be repeated a great many times, if necessary, with safety.

Since the introduction of prophylactic immunization, the disease has become quite rare. Passive immunization has resulted in a more prolonged period of incubation, a greater number of cases showing only local tetanus, and a marked reduction in mortality. Passive immunization is effected by giving an intramuscular dose of 3,000 units. This can be repeated in ten days.

At the present time, active immunization is practised. Three doses of alum precipitated toxoid may be used. The initial dose is 1 cc. subcutaneously. A similar amount is given one to three months later and a third similar dose one to three months after the second dose. Different time intervals are being tried out by the armed forces. Recent reports of active immunization against tetanus in this war show excellent results.

#### GAS GANGRENE

This condition is caused by gas producing organisms in wounded tissues, particularly muscles. The most common offending organism is the *Clostridium welchii*, with *Clostridium septique* and *oedmatiens* next in order of frequency.

It is true that the gas gangrene producing organisms are inhabitants of the soil, and that contaminated soil was the direct source of infection in these cases. However, recent observations, both clinical and experimental, have demonstrated that the infection is carried into the wound by the wounded wearing woolen clothing. All domestic animals harbor anaerobic organisms, but the sheep is the most important source of infection because its wool is used for clothing. Maes<sup>4</sup> did the following experiments to substantiate wool as the

source of anaerobic infection. He took twelve samples of wool, cotton and silk, dry-cleaned and pressed half of each sample. Cultures were then taken from the cleaned and unprepared portions of the samples. In eleven out of twelve pieces of wool, anaerobic organisms were found. None were found in the silk or the cotton samples.

Analyses of war experiences have shown that in World War I, most of the cases occurred during cold weather when woolen clothing was worn. In the recent Spanish Civil War where one of us (I. B.) had occasion to see and treat a large number of wounds, extremely few cases of gas gangrene were encountered. In China, in the Yangtze valley, where the soil is as richly manured as any land in the world, gas gangrene was uncommon. The same experiences were noted in Ethiopia. The common factor in the three countries mentioned above was the warm climate so that cotton clothing was worn.

There has been a report<sup>5</sup> of seven cases of gas gangrene on board a ship where soil could be excluded as a factor.

The predisposing factors are ragged penetrating wounds that severely damage muscle tissues, hematoma, or injuries to the vascular supply to the tissues. The buttocks, because they are easily contaminated by feces, and the lower extremities are the most common sites of gas gangrene. The upper parts of the body are uncommonly involved. Gunshot wounds of the retroperitoneal spaces that have traversed the rectum or colon are particularly prone to gas gangrene infection.

*Symptomatology.* In view of the fact that the gas bacillus causes hemolysis *in vivo*, the rapidly developing hemolytic anemia is explained and the peculiar discoloration of the skin, both locally and generally. The skin has a dirty-brown, yellow color, described as khaki colored, or it may even be blue tinged. The urine shows the characteristic color of methhemoglobinuria. The bacilli are sometimes recovered in the urine. Despite the fact that

the organisms traverse the kidneys, there is slight or no damage to the kidneys except for an occasional pyelitis. Schottmueller and Bingold,<sup>6</sup> reporting on a large series of cases, found only two instances of diffuse nephritis resulting from gas bacillus infection.

There is only a moderate temperature rise and chills are rare. The pulse rate is increased out of proportion to the temperature. Exhaustion is marked.

Locally there is an increase of pain in the wound. In the early stages, slight edema around the wound is present, and paleness rather than redness is the characteristic appearance. Crepitus may be present but this may be a misleading sign. The discharge from the wound may be very profuse and of mousy or musty odor. It is watery or rust colored. With marked progress of the disease in the muscle, the discharge has the characteristic rotten-meat odor. X-ray examination of the involved area may aid in the diagnosis, showing the presence of air.

Bacteriologic examination of the wound shows the presence of organisms and these should be typed to determine the exact organism present in order to use the specific serum if possible.

*Treatment.* Treatment consists of surgery, administration of antigas-gangrene serum and chemotherapy. Wounds should be opened widely, incisions being made parallel to the long axis of the limb. The deep fascia is cut transversely. All involved muscle must be excised until normal bleeding muscle tissue is reached. The process must be truly a débridement if good results are to be expected. In the fulminating type of cases, only an amputation may save the patient.

Despite the controversy as to the efficaciousness of serum therapy, one of us (I. B.) has seen excellent results with serum therapy. Therapy should be adequate; 80 to 100 cc. of polyvalent serum in 1,000 cc. of saline should be given by the drip method. If the type of organism is known, monovalent serum is given. The

dose can be repeated. In an established case 400 cc. of the serum can be given within the first four or five days.

Of the sulfa drugs, sulfathiazole is the choice. Its action is best when placed into the wound at the time of operation. Experimentally, the use of concomitant oral administration does not seem to enhance the efficacy of the drug.

There have been some excellent reports of x-ray therapy for the treatment of gas gangrene. Since there are some differences of opinion, it would be better to await the results of more extensive use of this type of therapy.

#### ANTHRAX

This condition is caused by the *Bacillus anthracis*, and is transmitted from herbivorous animals to man, chiefly by goats, sheep, hogs and cattle. It, therefore, occurs chiefly in individuals whose occupations bring them in contact with these animals, such as stable workers, butchers, furriers and tanners. There have been numerous cases reported from infection through contaminated shaving brushes.

There are three portals of entry in the human being: The gastrointestinal tract is one portal of entry, but this is quite rare. The respiratory tract is another uncommon mode of entry. The broken skin is by far the most usual route of infection, and the exposed parts of the body such as the face, neck, hands and forearms are most frequently affected. The skin wound may be so slight as to escape detection.

The incubation period varies from twelve hours to five days, with an average of about two to three days. The first sign is that of a flea-bite like lesion which soon becomes papular and is brownish in color. This is surrounded by an area of erythema. Marginal vesicles appear about the lesion and the area is surrounded by a non-pitting edema. The brown center becomes black and hard, extending to the dried crusted vesicles and into the depth. The vesicles at first discharge a clear, gelatinous-like fluid which contains the anthrax bacilli.

The discharge then becomes serosanguineous in appearance. The lesion is not painful, in contradistinction to carbuncles caused by the pyogenic organisms. Itching is a characteristic sign. The regional glands are involved in the majority of cases. They are painful and tender.

Systemic symptoms develop early, consisting of fever, fatigue and loss of appetite. In more severe cases, the systemic symptoms are much more in the foreground, consisting of vomiting, extreme exhaustion, high temperature, headache, pain in the joints, very rapid pulse, cyanosis, and often bloody diarrhea almost simulating that of cholera.

*Treatment.* The best results have been reported from the use of anti-anthrax serum and sulfa therapy. With proper treatment the mortality in cases of skin anthrax should be negligible.

Serum therapy has been well established. Large doses of anti-anthrax serum should be given and the dosage controlled by the recession of edema which is the best yardstick according to Gold.<sup>7</sup> An initial dose of 200 to 500 cc. of anti-anthrax serum should be given intravenously and repeated every twelve hours if the edema does not subside within eighteen to thirty-six hours. No serum should be injected about the local lesion. Persistently enlarged glands may be present even though the infection is under control. While pain and tenderness of the glands disappear early with successful treatment, persistent enlargement of the glands is no indication for further therapy.

Of the sulfa drugs, Gold<sup>7</sup> has found that sulfathiazole meets the requirements best. He gives an initial dose of 3 to 4 Gm. followed by 1 to 1.5 Gm. every four hours.

Comparing the results of serum with sulfonamides, he has found that chemotherapy has reduced hospitalization by slightly less than 50 per cent, and total disability by more than 50 per cent. If sulfa therapy does not control the edema within three days, shift treatment to large doses of serum.

## SUMMARY AND CONCLUSIONS

Attention has been called to the important rôle played by minor skin infections in the causation of sepsis.

The systemic manifestations are those of septicemia, if caused by the staphylococcus, streptococcus or gas bacillus. The systemic symptoms are those of toxemia if the primary skin infection is due to tetanus or anthrax.

Staphylococcal sepsis, in which the portal of entry was through the skin, has been classified into five groups.

Streptococcal sepsis originating from the skin is rare. However, minor hair follicle infections, streptococcal furuncles or carbuncles, or streptococcal infections of a punctured wound of the skin acquired during the performance of a surgical operation or an autopsy, are the most common causes.

Since the introduction of sulfa drugs, the management of sepsis has been very encouraging, with a marked reduction in mortality.

It has been pointed out that the prophylactic treatment for tetanus by active immunization has already yielded excellent results, so that in the armed forces, where active immunization is universally practiced, the disease has almost disappeared.

The modern accepted treatment of gas gangrene and anthrax have been described in detail.

## REFERENCES

1. BEER, E. Roentgenographic evidence of perinephritic abscess. *J. A. M. A.*, 90: 1375-1376, 1928.
2. LIPSETT, P. J. Roentgen-ray observations in acute perinephritic abscess. *J. A. M. A.*, 90: 1374-1375, 1928.
3. FIROR, W. M. Treatment and prevention of tetanus; collective review. *Internat. Abstr. Surg.*, 75: 185-190, 1942.
4. MAES, V. Gas gangrene, with special reference to importance of wool as a source of contamination. *Arch. Surg.*, 41: 393-402, 1940.
5. HINDHAUGH, A. Gas gangrene at sea. *J. Royal Naval Med. Serv.*, 27: 158, 1941.
6. SCHOTTMUELLER, H. and BINGOLD, K. Die septischen Erkrankungen Handbuch der Inneren Medizinen. Vol. 2, p. 776-954.
7. GOLD, H. A review of 60 cases, with a report on the therapeutic use of sulfonamide compounds. *Arch. Int. Med.*, 70: 785-821, 1942.



# REDUCTION AND AFTER-TREATMENT OF POSTERIOR DISLOCATION OF THE ELBOW

WITH SPECIAL ATTENTION TO THE BRACHIALIS MUSCLE AND MYOSITIS OSSIFICANS

LYON K. LOOMIS, M.D.

Resident in Orthopedic Surgery, Charity Hospital of Louisiana

NEW ORLEANS, LOUISIANA

**P**OSTERIOR dislocation of the elbow is a very common injury. Over a period of seven years at Massachusetts General Hospital, Wilson<sup>10</sup> reported elbow dislocation as the largest of any group of injuries of the elbow, exceeding even the common supracondylar fracture.

Posterior dislocation is usually caused by a fall upon the outstretched hand causing the elbow to become hyperextended. As hyperextension takes place, the olecranon process impinges against the olecranon fossa of the humerus and forces the lower end of the humerus past the coronoid process and through the anterior joint capsule into the brachialis muscle. Immediately following injury the patient usually flexes the elbow so that the surgeon first sees the elbow at an angle ranging from 90 to 135 degrees extension. There is usually a large amount of swelling about the elbow coming on within the first hour after injury.

The most common complications at the time of the injury include fractures of the medial epicondyle, the head of the radius, the olecranon and the coronoid process. The elbow is frequently also displaced laterally or, less frequently, medially. These complications are usually seen at the time of the injury and reduced at that time. It is a later complication,—myositis ossificans—that is most troublesome, often not anticipated and very frequently mistreated. Myositis ossificans is more common in the brachialis muscle than in any other muscle of the body.<sup>7</sup> It is also more common after posterior dislocation than

any other elbow injury.<sup>5,8</sup> Because of the frequency of new bone deposit in the brachialis muscle, this muscle should receive the greatest amount of consideration in the reduction of posterior dislocation.

## ANATOMY

The brachialis muscle is a large, fleshy muscle which originates from the anterior surface of the lower half of the humerus and inserts into the ulnar tuberosity and rough surface of the anterior coronoid process. (Fig. 1.) It is broad as it crosses the joint immediately anterior to the thin joint capsule, covering practically the whole joint and thus forming an important defense to the elbow joint.<sup>4</sup> Contrary to a common belief, the brachialis muscle does not form a tendon similar to the biceps but rather consists of both tendinous slips and muscle fiber bundles as it inserts. Many muscle bundles insert directly into the bone, especially the shorter fibers which originate lowest from the anterior and medial aspects of the humerus and insert on the proximal part of the rough surface of the anterior coronoid process. These muscle bundles lie directly anterior to the thin joint capsule. Thus, due to their anatomical position, they are especially vulnerable in posterior dislocation.

We have made cross-sections of the brachialis muscle in twenty different cadaver specimens directly opposite the humero-ulnar joint and attempted to determine as accurately as possible the percentage of muscle and tendon at this level where injury is likely to be most

severe. Planimeter measurements show that an average of 3.39 per cent of the muscle-tendon mass is tendon, the remaining 96.61 per cent being the soft vulnerable muscle belly. This offers striking contrast to the biceps which is practically 100 per cent tendon as it crosses the joint.

#### PATHOGENESIS OF MYOSITIS OSSIFICANS

Experimental production of posterior dislocation in the fresh cadaver specimen plainly shows the severe injury which affects the short fibers of the brachialis muscle. These muscle bundles are torn in their middle as well as many of the longer muscle bundles which are also torn and bruised.

It is not hard then to understand the pathogenesis of myositis ossificans, for, as Leriche and Pollicard<sup>6</sup> have so adequately pointed out, the ideal factors necessary for heterologous bone production are present: (1) the torn and bruised fibers lose their blood supply and degenerate; also, an intramuscular hematoma is formed; (2) calcium is available from periosteal stripping about the joint capsule attachments. In the presence of these two factors, preosseous substance is laid down.

The brachialis muscle is, therefore, a potential focus for new bone in every posterior dislocation and, although damage to muscle and periosteal stripping have already taken place at the time of injury, it becomes highly desirable to minimize additional trauma at the time of reduction.

#### REDUCTION

The usual method of reduction consists of extension and hyperextension of the elbow, followed by traction and flexion. It is thereby easy to secure a good bony reduction but only at the expense of the brachialis muscle. In reduction by this method, the ulna behaves as a second-class lever. As the elbow is extended to 180 degrees with the coronoid process in the olecranon fossa which acts as a fulcrum, force exerted at the end of the ulna is

multiplied approximately ten times at the brachialis muscle. When the elbow is hyperextended with the olecranon against the

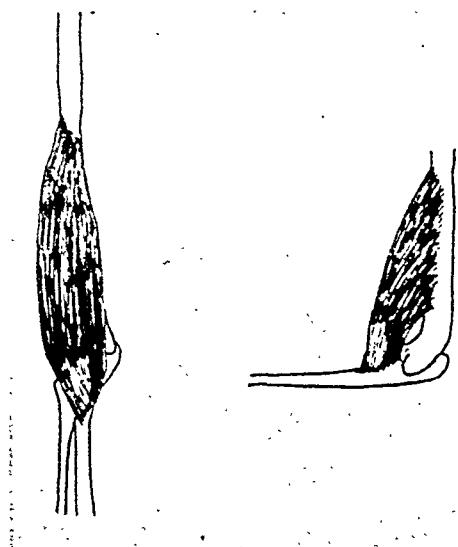


FIG. 1. The normal brachialis muscle is in a vulnerable position, especially the short fibers which originate lowest on the humerus and insert most proximally on the ulna.

posterior aspect of the humerus, there is roughly a five to one leverage system. A large amount of damaging stretch can thus be applied unthinkingly against the brachialis muscle.

Reduction by extension and hyperextension is said to be necessary in order to unlock the coronoid process from the olecranon fossa. Actually the coronoid process is only locked when the arm is in complete or nearly complete extension, and it can much better be unlocked in such a case by flexing the elbow to 90 degrees. Advocates of extension and hyperextension have asked the question, "How can re-extending and re-hyperextending the elbow do any more harm to the brachialis muscle than was done at the time of the injury, assuming that the injury was produced by hyperextension?" The answer to this question is obvious when it is realized that rarely is it possible to obtain a reduction within an hour after injury. By the time the patient reaches the surgeon and x-rays are completed, the elbow has changed. Marked swelling was present in all nineteen of our cases, even in those seen as early as one

hour following injury. Hemostasis in the muscle may be established by the time reduction is attempted. It is, therefore,

forearm in mid-pronation and analgesia given while x-rays are taken. If the diagnosis of posterior dislocation is confirmed by



FIG. 2. Mid-sagittal section through the elbow showing the distance in inches required for the muscle to stretch when reduced by flexion.



FIG. 3. Mid-sagittal section through the elbow showing the distance in inches required for the muscle to stretch when reduced by hyperextension.

apparent that repetition of extension and hyperextension is likely to start new hemorrhage. Also, traumatized muscle fibers may be in spasm by the time reduction is attempted so that the amount of extension and hyperextension which might have been harmless immediately after injury may be sufficient to damage further the spastic muscle fibers at the time reduction is attempted. Speed<sup>9</sup> pays tribute to this factor when he says that muscle spasm is the greatest obstacle to reduction of posterior dislocation.

We advocate reduction by flexion and traction of the elbow which in no way insults the brachialis muscle. (Fig. 2.) By this method the brachialis is relaxed as the arm is flexed to 90 degrees and needless stretch from extension and hyperextension is avoided. (Fig. 3.)

The exact method is in many ways similar to that of Bohler<sup>1</sup> and Crosby.<sup>2</sup> The patient presents himself to the surgeon holding his arm and his elbow at an angle of 90 to 135 degrees extension, usually about 125 degrees extension. The arm is splinted at 90 degrees flexion with the

x-ray, anesthesia is administered. General anesthesia is preferable although local or brachial plexus block may be used. The splint is removed and any lateral or medial dislocation is corrected. Strong traction is then applied to the forearm, keeping the elbow at 90 degrees flexion. Countertraction is furnished by an assistant who grasps the upper half of the humerus or the patient may be strapped to the table using a heavy felt axillary pad. The forearm is kept in mid-pronation during traction to relax the pronator teres which is usually injured in posterior dislocation.<sup>1</sup> The operator uses both hands in applying traction, one hand being at the wrist and the other hand near the elbow. (Fig. 4.) Following traction the elbow is flexed to roughly 70 degrees and maintained in flexion with one hand at the wrist while with the other hand strong pressure is exerted on the anterior aspect of the lower humerus which accomplishes reduction. (Fig. 5.) It is important that the elbow be flexed beyond 90 degrees before pressure is exerted on the humerus, for in such position the coronoid process will not be fractured. (Fig. 2.)

## AFTER-TREATMENT

A review of the literature of the past fifteen years reveals a tendency for the

motion as early as two days following injury. We do not believe in early motion.

Whether new bone is laid down around



FIG. 4. The elbow is flexed to 90 degrees to relax the brachialis muscle and traction is applied to the forearm in mid-pronation to relax the pronator teres.



FIG. 5. The elbow is flexed beyond 90 degrees while pressure is exerted on the lower humerus to avoid fracture of the coronoid process.



FIG. 6. With the elbow flexed beyond 90 degrees the arm is placed in a posterior plaster of Paris splint until swelling subsides.

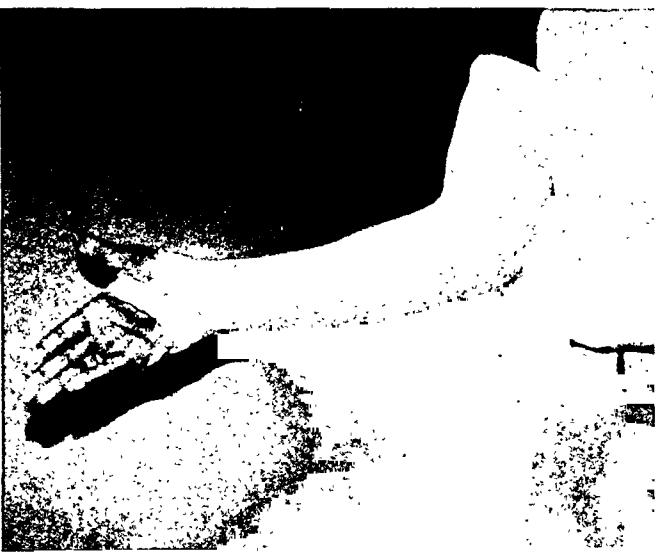


FIG. 7. The completed unpadded cast is trimmed around the thumb and back to the proximal palmar crease to enable the patient to use his hand.

most part to immobilize the injury after reduction in a position of hyperflexion for two to three weeks. However, two papers<sup>3,11</sup> have appeared during this time advocating

the capsule or in the brachialis muscle, resorption of the excess new bone is greater if the extremity is immobilized.<sup>6</sup> An understanding of the pathogenesis of excess new

bone helps to clarify this statement. A mass of new bone in muscle is an obstruction to normal muscle function. Normal muscle fibers adjacent to the calciferous deposit are repeatedly traumatized and offer new foci for more new bone formation if motion is allowed. The process is, therefore, a vicious cycle which can only be interrupted by immobilization. Equally important is the maintenance of a good blood flow through the injured extremity since good circulation will also hasten the resorption of excess new bone.<sup>6</sup>

With these two facts in mind, we have adopted the following treatment. After reduction of the posterior dislocation, a posterior plaster of Paris splint is applied with the elbow at about 80 degrees flexion, provided the radial pulse is satisfactory at this angle. (Fig. 6.) The forearm is placed in mid-pronation as previously mentioned, to relax the pronator teres. The injured elbow is elevated 45 degrees above the body level for at least forty-eight hours and the radial pulse checked frequently. At the end of a week if the swelling around the elbow has reached a minimum, a light unpadded plaster of Paris cast is applied with the elbow at the position of function (90 to 110 degrees). The cast should extend from the axilla to the metacarpophalangeal joints on the dorsum of the hand and must be trimmed around the thumb and in the palm back to the proximal palmar crease. (Fig. 7.) The patient can thus carry out his work in most instances. A lightweight unpadded cast is essential as the patient will not use his arm with a heavy cast. The patient is advised to use his hand with the cast on, to carry out his occupation if possible and not to carry the arm in a sling. He is told to place the arm over the head and behind the back twenty times daily which prevents atrophy of shoulder muscles. Weekly visits are essential to make sure that these instructions are carried out. The cast is removed in three to four weeks

and x-rays taken for excess new bone in the brachialis muscle or around the capsule. If this is found, immobilization in plaster must be continued until the calciferous mass disappears.

We have, therefore, attempted to meet the requirements for the resorption of excess new bone by providing a light unpadded cast which can be well molded to the arm, gripping the skin creases as well as the hairs of the arm. A good flow of blood is continually pumped through the injured extremity as the patient uses the hand. The functional advantages are many. When the cast is removed, there is little or no muscle atrophy; the hand grip is strong, the muscle tone and skin texture good. The elbow usually has 60 to 90 degrees range of motion upon removing the cast. Active motion is easily begun and there is less need for physiotherapy. All of our patients have carried out their occupations while wearing their casts and the economic advantages are thus evident.

#### REFERENCES

1. BOHLER, L. Treatment of Fractures. Pp. 205-207. Baltimore, 1936. William Wood & Co.
2. CROSBY, E. H. Elbow dislocations reduced by traction in four different directions. *J. Bone & Joint Surg.*, 18: 1077, 1936.
3. GLISSAN, D. J. After treatment of dislocation of the elbow with a note on the treatment of stiff elbows. *Australian & New Zealand J. Surg.*, 5: 134, 1935.
4. GRAY, H. Anatomy of the Human Body. 24th ed., p. 440. Philadelphia, 1942. Lea & Febiger.
5. KINI, M. G. Dislocation of the elbow and its complications. *J. Bone & Joint Surg.*, 22: 107, 1940.
6. LERICHE, R. and POLICARD, A. The Normal and Pathological Physiology of Bone: Its Problems (English translation by Sherwood Moor and J. Albert Key). St. Louis, 1928. C. V. Mosby Co.
7. PAINTER, C. F. A consideration of the etiological factors in myositis ossificans traumatica. *Boston M. & S. J.*, 185: 45, 1921.
8. SCUDDER, C. L. The Treatment of Fractures. 11th ed., p. 799. Philadelphia and London, 1938. W. B. Saunders Co.
9. SPEED, K. Fractures and Dislocations. 4th ed., p. 547. Philadelphia, 1942. Lea & Febiger.
10. WILSON, P. D. Fractures and dislocations in region of elbow. *Surg., Gynec. & Obst.*, 56: 335, 1933.
11. WOODS, R. S. Backward dislocation of the elbow. *Brit. M. J.*, 1: 15, 1935.

# ACUTE PERFORATED DUODENAL ULCER

VERNE G. BURDEN, M.D.

Attending Surgeon, St. Joseph's and Fitzgerald-Mercy Hospitals

PHILADELPHIA, PENNSYLVANIA

THE ever present threat of perforation is a deadly menace to the patient who has a duodenal ulcer. The incidence of perforation is not known but it seems to have geographic variations. It is more frequent in England than in this country. A chronic duodenal ulcer may be present for eight or ten years and suddenly perforate or perforation may be the first and only symptom. As yet, there is no explanation for this unusual behavior. There is very little assurance in the prevention of perforation by medical treatment. However, perforation of a duodenal ulcer is extremely rare after gastroenterostomy because the original ulcer almost invariably heals.

Acute perforation of a duodenal ulcer necessitates an immediate operation. There are no recognized reasons for delay. The obvious surgical procedure is closure of the perforation. Whether this should be supplemented by gastroenterostomy is a question on which there are different opinions. Statistics do not afford the answer. The figures for surgical mortality vary and depend on many factors; the one most commonly stressed is the interval of time between perforation and operation. Cultures of the peritoneal fluid in the early hours after perforation usually are sterile—probably the result of the action of hydrochloric acid in the stomach. Later the cultures often show pathogenic bacteria and there is evidence of peritonitis. The nature of the contents of the stomach may or may not have a bearing on the virulence of the peritoneal process. Patients with duodenal ulcer usually have an abundance of free hydrochloric acid in the stomach but there is no available information as to the length of time required for ingested fluid

to be rendered free of bacteria by the action of the acid; or, for that matter, if it ever becomes sterile. It may be assumed that after a meal has been completely acted upon by the stomach the resultant mixture is sterile, but surely it is not uncommon for food stuff to leave the stomach and enter the duodenum before the above process is complete.

Casting theory and speculation aside, it stands as a fact, as in many other surgical conditions, the earlier the operation the lower the mortality. Without surgical help, these patients usually die of peritonitis, which is also the most common cause of death after operation. The operative procedure may be accused of contributory negligence if a duodenal fistula or a subphrenic abscess occurs. No patient with acute perforation of a duodenal ulcer, regardless of delay or degree of peritonitis, should be denied the chance which only operation can offer. Surgery is subject to a multitude of human diversities. No two "cases" are alike. The mortality of an operation in a thousand reported cases may be 5 per cent but for the patient who dies it is 100 per cent. A competent surgeon may encounter a series of fatalities because of uncontrollable circumstances and a tyro may have a number, large or small, of the same type of case without a death. After all, is it not true that the surgeon when confronted by a problem in the individual patient is by duty bound to do the right thing at the right time and let statistics fall where they may? To do this requires, of course, training and experience, and that which is more important, observant and thoughtful consideration of pathologic states and physiologic changes.

The mortality of operation in acute perforation, before twelve hours, should be under 10 per cent; after that interval it rapidly increases. Peritonitis is the most frequent cause of death even in those patients who succumb after an early operation. The peritoneal fluid is not always sterile in the first four or five hours after perforation and it is not always true that early operation means recovery. Death may be the result of subphrenic abscess and pulmonary complications.

Is it not an obvious fact that all duodenal ulcers are potential cases of perforation? It is impossible to separate into clinical groups ulcers which will bleed, ulcers which will perforate, ulcers which will cicatrize and stenose, and those which will run a smooth uneventful prolonged course. There is no basis in fact for the assertion that bleeding ulcers do not perforate. The natural history of duodenal ulcer is characterized by alternate healing and reactivation. Usually these phases correspond with clinical symptoms. Ulcers which have no tendency to heal do not show scar tissue. It is rare for the surgeon to expose a chronic duodenal ulcer without evidence of scar tissue. An exception is duodenitis in which a definite ulcer is absent. In the picture of an acute perforation of the duodenum there is usually very little if any evidence of scar tissue to indicate the presence of chronic ulceration. I have no positive conviction that only acute ulcers perforate but in my experience the findings at operation and the frequent absence of ulcer symptoms prior to perforation strongly suggest it. In not a few cases of duodenal ulcer the first symptom is either from perforation or hemorrhage. It is significant of an acute process that some patients experience a short preperforative period of one to three weeks in which the symptoms of ulcer are intense and constant and the usual methods of relief as by antacid powders and diet are of no avail. In these patients perforation seems to be inevitable, but usually one is unable to foretell this

catastrophe. Medical treatment does not prevent, and I seriously doubt that it even reduces the incidence of perforation. There are authentic records of patients who have suffered a perforation while confined to bed under hospital treatment. One of my patients had an acute perforation within a few minutes after a barium meal for an x-ray examination of his stomach.

The effect of injury or strain of the abdominal wall as a cause of rupture of an ulcer has received occasional comment. One of my patients, a structural iron worker, had an acute perforation of a duodenal ulcer while he was holding a rivetting hammer against his abdomen. Of course, this may have been a coincidence and not cause and effect. However, there are many instances on record in which perforation followed so close upon muscular effort associated with lifting, cranking a motor and in some cases direct blows to the abdomen, that an etiologic relationship may not be unlikely. I suspect that the general concept of the process of perforation of a duodenal ulcer is a progressive erosion through the coats of the duodenal wall until the protective covering on the peritoneal side becomes so thin that, like the blowout of a worn automobile tire, sudden explosive rupture occurs. Anyone who has given some thought to the appearance of a duodenal perforation at the operating table knows the utter fallacy of the above theory. The picture of the perforation is nearly always the same. It is not a tear nor is it a blowout. There is nothing about it to suggest physical force from without or from within. It is always a clean-cut rounded hole. A quiescent or healed ulcer does not perforate nor rupture. The evidence indicates that acute perforation occurs only in an acute ulcer or in a chronic one which has undergone acute exacerbation. The actual perforation is the result of an active ulcerative process which usually is rather rapid from start to finish because one rarely sees protective adhesions.

The recognition of an acute perforation of a duodenal ulcer is so easy that it is difficult to explain the long delay which often occurs before operation. Unlike the symptoms of acute appendicitis those of perforated ulcer are dramatic and faithfully characteristic. I saw a patient within a few minutes after his ulcer perforated. He had severe upper abdominal pain and localized tenderness but rigidity of the muscles had not yet appeared. There was not the slightest indication of shock and the pulse and temperature were normal. At operation, less than two hours later, there was an opening about 1 cm. in diameter in the duodenum from which bile-stained fluid was pouring into the free peritoneal cavity. Within a short time after perforation the pain becomes agonizingly severe; it is constant and without remission. At the same time there develops a rigidity of the abdominal muscles, more pronounced in the upper part, which is board-like and serves to splint and to immobilize the entire abdomen. In no other condition is there rigidity such as this; it is the most characteristic physical finding. The patient remains flat on his back and is afraid to change from this position. Vomiting is not common. Grunting respiration is a characteristic symptom. A flat x-ray plate of the abdomen for detection of an air bubble under the diaphragm is said to be of diagnostic importance. It has been my experience in the surgical diagnosis of acute abdominal conditions that the more laboratory aids are brought into use the more likely it is for confusion to replace clear thinking and the patient becomes the loser as the result of indecision and delay. There is one forgivable error in the diagnosis of perforated ulcer—acute perforative appendicitis. After the lapse of a few hours the fluid from the perforation follows a natural drainage path as pointed out by Moynihan years ago, down the outer side of the right colon, over the region of the appendix and into the pelvis. In such cases, usually late, there is tenderness and rigidity over the area of the appendix and often a

tender pelvic mass by rectal palpation. Fortunately, these findings usually call for immediate operation. Once the abdomen is opened, the character of the peritoneal fluid noted and the appendix examined, the observant surgeon will readily recognize the situation and act accordingly; thereby no harm has come to the patient.

Occasionally, one will see a patient ten or twelve hours after the onset of sudden and severe upper abdominal pain. At present he is sitting in a chair and he is able to walk about the room. The pulse and temperature are normal. The only complaint is epigastric soreness. Palpation of the abdomen detects board-like rigidity which is confined to the right upper quadrant and firm pressure elicits deep tenderness. It is difficult to convince him that he should submit to operation. Exploration reveals a perforated duodenal ulcer which has become loosely sealed to the under-surface of the liver. The attachment is so insecure that it lets go with the slightest manipulation and it is a great satisfaction to the surgeon that he is at once prepared to prevent an inevitable disaster. The above circumstances occurred in a patient upon whom I operated eighteen hours after perforation. He recovered promptly after closure of the perforation and a posterior gastroenterostomy, and has remained entirely well to date now eight years after operation.

The method of anesthesia is of great importance but it has been consistently ignored or unrecognized in discussions of the subject. The anesthetist often has difficulty in maintaining a smooth anesthesia with gas or ether, and in such instances postoperative pulmonary complications seem to be more frequent. Of greater importance is the almost constant difficulty in obtaining relaxation of the abdominal muscles so that it becomes necessary for the surgeon to fight his way through guarded muscles and the cantankerous annoyance of protruding abdominal contents. Under these conditions the handling of a grave surgical lesion

which requires impeccable technic may be an extremely difficult task. Is it not possible that the above situation, not always conducive to tranquillity of mind and procedure, has had something to do with the oft repeated admonition that these patients are desperately ill, that only emergency treatment, namely, closure of the perforation is justified and that gastroenterostomy subjects the patient to undue prolongation of the operation? Complete relaxation can be obtained with spinal anesthesia which I have used in these cases for sixteen years. Under its influence the field of operation is quiet, there is less traumatism to peritoneal surfaces; accurate technic is favored; the surgical procedure can be carried out in an unhurried manner and an additional fifteen minutes for a gastroenterostomy does not increase the operative risk. A patient with a perforated duodenal ulcer, other things being equal, stands as good a chance for recovery after forty-five minutes on the operating table as another similar patient who has been there only thirty minutes. Operations many times are prolonged by clumsy operating, unnecessary maneuvers, needless handling of tissues and failure to complete one technical detail before moving on to the next. In my experience spinal anesthesia has been more satisfactory than any other method and equally safe.

The preoperative diagnosis usually is correct and the incision properly placed. When through error of diagnosis (appendicitis) the incision has been made in the right lower quadrant the true state of affairs is soon revealed. Remove the appendix and close the incision; then make a separate incision in the right upper quadrant. Occasionally, it may be wise to use the lower incision for the insertion of a drain. When the peritoneum is opened, the diagnosis is confirmed by the appearance of bile-stained fluid which contains flakes of plastic exudate and often small bits of food débris. In many instances gas bubbles are seen. The fluid should be mopped up with large moist gauze sponges or removed

by suction. The stomach is then pulled downward and to the patient's right, handed to an assistant who holds it with a dry sponge and turns it toward the patient's left. By this maneuver the site of perforation in the duodenum is freely exposed and the parts are under perfect control for closure of the perforation. Moist gauze pads should be judiciously placed to prevent further soiling of the peritoneum. During these manipulations one must be exceedingly careful to prevent the free fluid from gaining access to the space between the undersurface of the liver and the diaphragm. This region is difficult to cleanse properly and methods for draining it are inadequate. The danger, of course, is the development of a subphrenic abscess. It is remarkable how quickly plastic exudate forms after a perforation of a duodenal ulcer; it is not uncommon to find the perforated part of the duodenum loosely adherent to the undersurface of the right lobe of the liver. Leakage from the opening rarely is completely checked but usually materially lessened, so that the spreading of peritonitis is temporarily halted and localized. I have never seen the great omentum taking part in sealing over the perforation. In many instances, on the other hand, it is not uncommon to expose a perforation which is as free as a leak in a rainspout and pouring forth fluid containing particles of undigested food which may be infested with bacteria. It is obvious that the interval of time between perforation and operation in the first instance is comparatively unimportant while in the latter it becomes the chief determining factor in prognosis. Such factors, and they are rarely mentioned, have a profound effect upon statistics and on the patient.

Free perforation of a duodenal ulcer presents a characteristic picture at the operating table. Invariably there is a round pyunched out opening 5 to 8 mm. in diameter and about 2 to 4 cm. distal from the pylorus on the antero-superior surface of the duodenum. For a distance of 2 or

3 cm. around the opening the duodenum shows the grey pallor of inflammatory edema; its wall is much thicker than normal and has lost its pliable, supple quality. Because of these local tissue changes sutures easily tear out. Infolding of the perforation is almost impossible and secure accurate closure as we would deem a necessity for an opening elsewhere in the bowel cannot be accomplished.

With the duodenum adequately exposed and the perforation visualized, it is closed by three or four through-and-through cotton sutures which are placed longitudinally or transversely depending upon the ease of closure. Several pieces of nearby mesenteric fat or omental tabs are included by a third knot in the above sutures, thereby making the closure more secure against leakage. No effort is made to infold the perforated area and only one layer of sutures is used. Only enough is done to close the opening because too much suturing is likely to favor leakage and to weaken the closure. After the perforation is exposed and before the closure is made, it is my practice to clean out by the use of large moist sponges and suction all accessible free fluid. Large moist gauze pads are then placed around the area of perforation, a pad in the subhepatic space, another pad between the undersurface of the liver and the duodenum which serves to prevent contaminated fluid gaining access to the space between the liver and diaphragm, and another moist sponge is placed just above the duodenum. I believe that the proper disposition of gauze in operations for perforated duodenal ulcer is second in importance only to a similar precautionary measure in cases of acute perforated appendicitis. Too often, fatal peritonitis is man-made. A posterior short-loop gastroenterostomy is now made. My reasons for doing a posterior gastroenterostomy are based on the following personal convictions. A duodenal ulcer is a local manifestation of disturbed physiology of the stomach; acute perforation of the ulcer is a complication and not a cure of the

disease. Closure of the perforation alone may save the patient's life but he is left in a state of potential danger of another perforation. The high rate of recurrence of duodenal ulcer after local excision certainly does not support the theory that perforation cures the ulcer. On the other hand, the rate of recurrence of ulcer in the duodenum following gastroenterostomy is very low. At least two-thirds of the patients who have had a simple closure of an acute perforation experience symptoms indicative of recurrence of the ulcer. Does the addition of gastroenterostomy increase the operative risk? I believe that the operation in competent hands actually is a safety measure so far as the immediate condition is concerned. Certainly the additional fifteen minutes does not increase the risk, so that, the only factor of danger would be some technical error in the operation itself. The performance of gastroenterostomy affords definite protection to the recently sutured opening in the duodenum. Under the best conditions this closure is not secure. The resumption of traffic over the weakened and partially devitalized area immediately after suture and the added physiologic distention resulting from forceful ejection of contents from the stomach make the margin of safety very narrow from the standpoint of leakage. In cases of death from peritonitis or from subdiaphragmatic abscess after simple closure of a perforated ulcer, is it not probable that leakage at the suture line of closure has been at fault? The necessity of a gastroenterostomy should not depend upon any apparent narrowing of the lumen of the duodenum incident to closure of the perforation. After the inflammatory edema has subsided and healing has occurred it will be found, as it usually is at subsequent operations, that the duodenal lumen is entirely adequate. I believe that the making of a gastroenterostomy will prevent or lessen the dangers described in the preceding remarks. I have known of several instances in which duodenal fistulas followed simple closure of a perfora-

tion although I am not prepared to say that the complication would have been prevented by a gastroenterostomy. It is reasonably certain that for a varying length of time after closure of an acute perforation there is more or less physiologic or anatomic obstruction to the emptying of the stomach. I have performed gastroenterostomy in five patients for recurrence of duodenal ulcer several years after simple closure of an acute perforation. In these cases the duodenum and pylorus were inseparably adherent to the undersurface of the right lobe of the liver, thereby constituting a mechanical fault as far as the function of the pylorus was concerned. Without attempting to separate the adhesions, a careful inspection revealed inflammatory changes with evidence of the presence of active duodenal ulceration. Is it not probable that by sealing the duodenum to the undersurface of the liver nature had done more than the surgeon to close the perforation and to prevent a spreading peritonitis? At any rate the mechanical derangement of the pyloric region of the stomach incident to this condition even in the absence of active duodenal ulceration would be a sufficient reason for the making of a gastroenterostomy. Then, too, it is possible for this mechanical derangement of the pylorus actually to favor the recurrence of duodenal ulceration. The patient with a duodenal ulcer has a constitutional disorder of the function of the stomach which will continue to form ulceration in the duodenum regardless of whether the ulcer is perforated or surgically excised. In a small percentage of cases, this constitutional defect favors the formation of an ulcer in the stoma of the anastomosis when the gastroenterostomy has failed in its primary purpose, namely, the control of excessive gastric acidity.

It is a well known fact that slow, pinpoint perforation of a duodenal ulcer rarely gives rise to spreading peritonitis. The slowness of the leakage permits ample time for the formation of protective adhesions to nearby structures. Usually, these pa-

tients have had a duodenal ulcer for years and then rather suddenly the mild intermittent symptoms of ulcer are replaced by constant localized epigastric pain. It may be severe but it is never so acute as when free perforation has occurred. There is no board-like rigidity of the abdomen, only localized tenderness. Gastric retention and vomiting may be present. Does not this situation call for urgent surgical relief? Would it be sound surgical judgment to separate the adhesions which seal the perforation to the undersurface of the liver and then to close the perforation and let it go at that? I believe that nearly every surgeon would leave the local condition strictly alone and consider the situation an ideal indication for the making of a gastroenterostomy. If gastroenterostomy is indicated for this kind of perforation, why should it not be equally applicable in the case of acute free perforation? It seems to me that the only logical reason for the omission of gastroenterostomy in the case of acute perforation is the alleged risk incident to the prolongation of the operation, especially in the presence of advanced peritonitis. The omission of gastroenterostomy may be justifiable on the grounds of expediency, but imperfect postoperative results are likely to follow in 40 to 60 per cent of the patients. In this group there will be instances of second perforation and the majority will require gastroenterostomy because of the persistence of the symptoms of duodenal ulceration. These events will carry their own risks and mortality figures. After all is said and done, gastroenterostomy in spite of its faults, failures and misuses remains the most satisfactory method of treatment in properly selected cases of duodenal ulcer. This is true because it insures nature's own control of the vicarious acidity of hypersecretion which amounts to a constitutional fault in the ulcer bearing patient. This fault of gastric chemistry is part of the patient's makeup and as such is intractable and persistent. To ignore this tenet in the treatment of a perforated

duodenal ulcer is to invite recurrence. The present state of development of surgical technic demands in the case of the patient with perforation not only that his life be saved by closure of the perforation but that his future be relieved of the anxiety and ill health incident to the lesion which originally laid him low.

from the surrounding territory. Many patients have died of peritonitis in spite of drainage but I do not know of any instance in which death from peritonitis has been attributed to the failure to insert a drain. There are fewer indications for the suprapubic drain than there are for a drain through the operative incision. A word of

TABLE I

				Operative Procedure				Anesthesia	Deaths
	Age	Sex	Duration of Perforation	Closure of Perforation	Gastro-enterostomy	Appendectomy	Drainage		
1	D. W.	33	M	*	*	*	*	o	Spinal
2	D. B.	57	M	*	*	*	*	o	Spinal
3	J. K.	22	M	5 hrs.	*	*	*	o	Spinal
4	E. L.	59	M	14 hrs.	*	*	o	o	Spinal
5	J. S.	32	M	4 hrs.	*	*	o	o	Spinal
6	S. F.	42	M	6 hrs.	*	*	*	o	Spinal
7	C. B.	30	M	6 hrs.	*	*	o	o	Spinal
8	R. B.	33	M	8 hrs.	*	*	*	o	Spinal
9	J. F.	34	M	5 hrs.	*	*	*	o	Spinal
10	G. B.	49	M	4 hrs.	*	*	o	o	Spinal
11	M. A.	30	M	2½ hrs.	*	*	*	o	Spinal
12	T. B.	38	M	18 hrs.	*	*	o	o	Spinal
13	J. F.	46	M	5 hrs.	*	*	o	o	Spinal
14	J. W.	18	F	12 hrs.	*	*	*	o	Ether
15	J. X. P.	47	M	5 hrs.	*	*	o	o	Spinal
16	E. S.	19	M	10 hrs.	*	*	*	o	Spinal
17	J. Mc. A.	43	M	7 hrs.	*	*	*	o	Spinal
18	R. M.	33	M	14 hrs.	*	*	*	o	Spinal
19	E. P.	24	M	8 hrs.	*	*	*	o	Spinal

\* = yes.

o = no.

The matter of drainage after operation for acute perforation cannot be settled by statistical study, nor can rules of procedure be laid down. Usually the insertion of a drain does no harm, but that does not constitute a reason for using it. If one is uncertain about the security of the closure of the perforation and has not done a gastroenterostomy, the use of a drain may be a safety procedure. There is always peritoneal contamination in these cases but if one must use a drain on this basis, where should it be placed? Bear in mind that a drain only serves to form a sealed-off outlet to which there are no tributaries

warning should be said regarding the placement of the drain when it is used. To place the end of the drain, whether it be of the cigarette type or a plain rubber tube, down to and possibly in contact with the site of the closed perforation in the duodenum is a dangerous procedure because it favors or may actually incite leakage from the suture line. I suspect in many cases in which an apparent laudable purpose has been served by the drain, so that the surgeon could point with pride to his justifiable practice, that if the truth were known there would have been no drainage or leakage if the drain had been omitted.

## SUMMARY

This report is based on a personal experience with nineteen patients who were operated upon for acute perforation of a duodenal ulcer. Closure of the perforation and posterior gastroenterostomy was done in all and in twelve the appendix was removed. Drainage was used in only two cases. There was one death. This patient who was admitted in a state of shock five hours after perforation and operated upon at once died twenty-four hours later. The youngest, and only female in the group, was a girl of eighteen years. This is not a selected group but one which contains all cases of acute perforated duodenal ulcer which have come under my care in the past fifteen years.

Many perforated duodenal ulcers become sealed temporarily to the undersurface of the liver, thereby preventing for a time widespread contamination of the peritoneum.

Acute perforation is the result of an acute ulcerative process in either a recent or an old ulcer. The perforation is caused

by erosion (acid) and not by rupture from increased pressure.

The operation of choice should be closure of the perforation and posterior gastroenterostomy. The closure is made by three or four through-and-through cotton sutures re-enforced by several nearby fat tabs. Do not infold; do not use a purse-string suture.

Except in the presence of advanced peritonitis, gastroenterostomy is advisable because (1) perforation does not cure the ulcer. Simple closure is followed by recurrence of ulcer in 40 to 60 per cent of the patients and in others the stomach may have motor difficulty from fixation of the pylorus to the undersurface of the liver. Gastroenterostomy is the best safeguard against recurrence and motor dysfunction of the stomach. (2) It protects the sutured area of perforation against tension and leakage. (3) It does not increase the operative risk.

When the appendix is readily accessible, it should be removed. Spinal anesthesia is recommended except in the presence of shock. Drainage is rarely indicated.



# REPAIR OF URINARY BLADDER HERNIATION

ALFRED H. IASON, M.D.

Attending Surgeon, Adelphi Hospital; Director of Surgery, Brooklyn Home for the Aged  
BROOKLYN, NEW YORK

ONE of the most difficult varieties of hernia to repair is that in which the minor or major part of the content is a protruded bladder wall. This may be either of the primary or the secondary form.

The chief objective in the surgical correction hereinafter described is, manifestly, a permanent cure.

Hernia of the bladder was first referred to by Abulcasis in the twelfth century, and by Guy de Chauliac (1363). The latter surgeon described the technic of the passage of a catheter as an aid in diagnosis. The first recorded case was that of G. D. Sala, of Padua (1620). Plater (1550) also described a bladder hernia.

## INCIDENCE

Urinary bladder hernia is either a complication or an integral part of an inguinal hernia. Various statistical studies reveal an incidence of 1 to 3 per cent, but in my experience it is at least 10 per cent in patients over fifty years of age with inguinal hernias of even moderate size.

In recurrences following inguinal hernioplasties some surgeons give a percentage as high as 25.5.

In 1935, I summarized my views regarding this subject, to the effect that the so-called recurrences after operations for inguinal hernia are not, as a rule, true recurrences which reveal a definite reformed sac, but are more frequently either a return of the condition imperfectly repaired or a postoperative incisional inguinal hernia. In either instance the protruding structure is frequently the bladder. Incisional hernias occur in an older age group with poor musculature and obesity; this must be borne in mind

at the first surgical procedure as re-operation usually produces another so-called "recurrence."

The fundamental cause, in the past, was timidity on the part of the surgeon to open the bladder protrusion and also failure to analyze the anatomic basis for the condition, which, in reality, was present prior to the first attempt at surgical repair.

## VARIETIES

Three main anatomic varieties of bladder herniation have been described; (1) Intrapерitoneal—the bladder diverticulum is a component of the hernial sac; (2) paraperitoneal—the hernial protrusion is covered peritoneally only on one side (the most common variety); (3) extraperitoneal—when a sac is present, the bladder is distinct from, and medial to it.

This classification, though accurate, is inadequate and is not descriptive enough. Therefore, I offer the following five types, based primarily on a surgical-anatomical foundation (Fig. 1):

1. As part of a direct inguinal hernia through Hesselbach's triangle, without evidence of an indirect inguinal sac. The size varies from a protrusion about an inch in diameter to one of several inches; the base is sessile and covered by an attenuated transversalis fascia; the inferior epigastric blood vessels may be partly displaced laterally. (Figs. 1D, 2 and 3.)

2. As a complication of an indirect inguinal hernia in which there is no direct connection between the bladder protrusion and the indirect inguinal component. (Figs. 1E and 4.)

3. As the medial part of a large saddlebag or pantaloон hernia in which the lateral bladder wall protrusion is part of

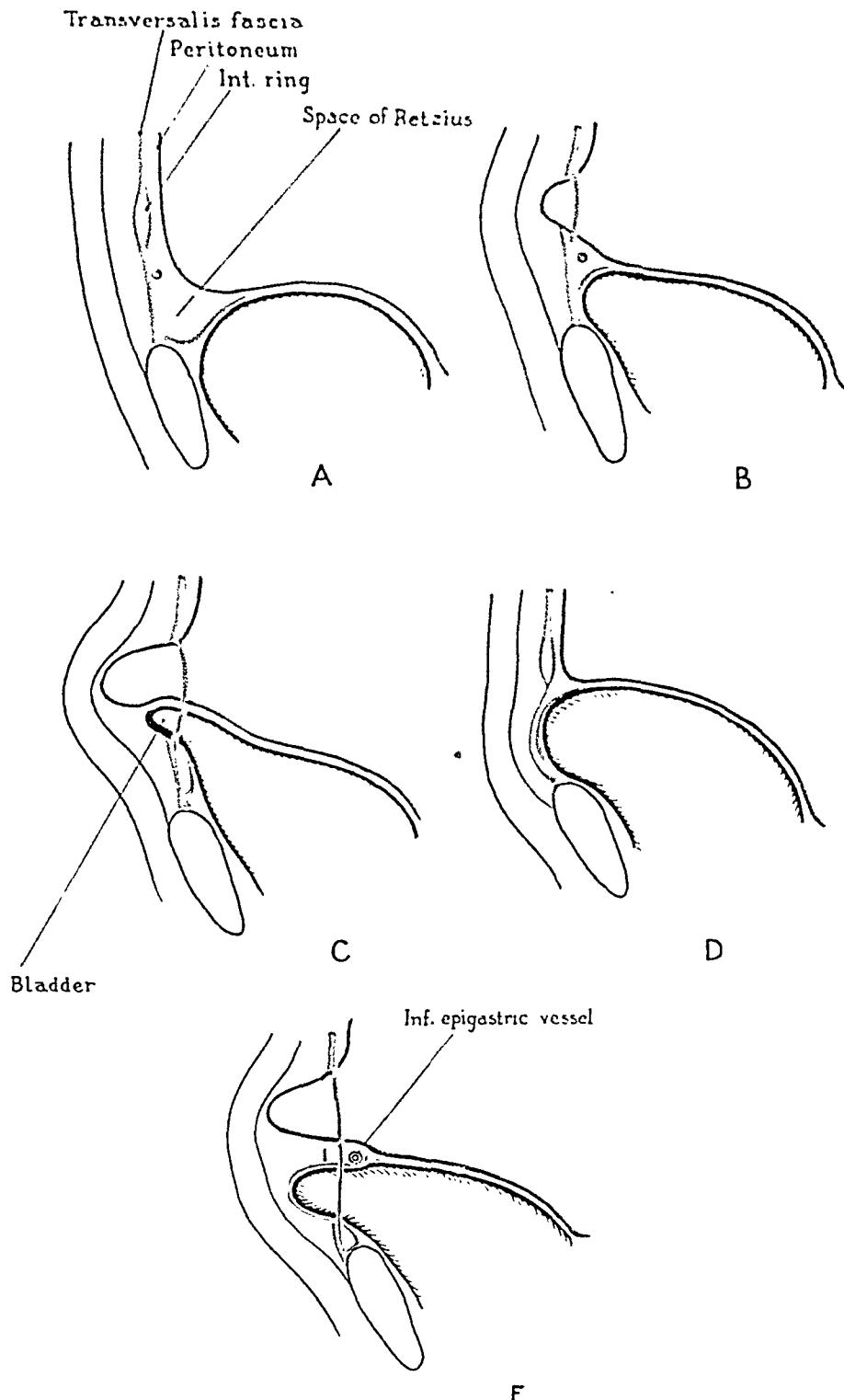


FIG. 1. A, normal relationship of peritoneum, transversalis fascia and bladder. B, small indirect inguinal hernia showing dilated deep ring and effect on bladder wall. C, later stage showing bladder hernia complicating indirect inguinal hernia. D, bladder hernia; no evidence of indirect inguinal hernia. E, saddle-bag or pantaloone hernia; the bladder forms the medial protrusion.

the medial wall of an indirect hernial sac. (In this variety, as in the two preceding, the transversalis fascia is attenuated to an

condition is, in reality, a sliding hernia of the bladder. This is especially true of massive hernias. On rare occasions the intra-

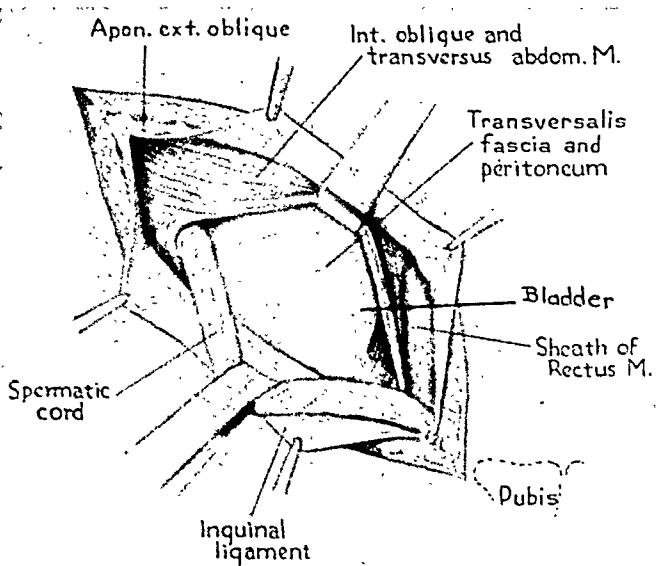


FIG. 2. Bladder protrusion in a direct inguinal hernia.

extreme degree and the only dividing line between the bladder protrusion and the indirect hernial sac is a cleft formed by the

peritoneal part of the bladder lies directly within the complete hernial sac. (Figs. 1c, and 5.)



FIG. 3. Large direct right inguinal hernia; no evidence of an indirect hernia. The bladder constituted the entire hernia.

inferior epigastric vessels.) Here, the bladder hernia is enlarged owing to peritoneal traction or tension as the indirect sac grows. The urinary bladder wall enters the hernial sac in one of two ways: A part of its wall fuses with the medial wall of the hernial sac so that the bladder proper, in effect, forms one of the sac layers. The



FIG. 4. Saddle-bag or pantaloone hernia—type 3.

4. Recurrent inguinal hernia (so-called) is frequently an incompletely repaired saddlebag or direct inguinal hernia. (Fig. 6.)

5. Femoral bladder hernia. (Fig. 7.)

The following varieties of bladder hernias have been reported in the literature on extremely rare occasions: (1) Obturator (extraperitoneal); (2) suprapubic—through

the linea alba; (3) ischiorectal, and (4) Gironcoli's—a protrusion directly through the rectus abdominis muscle. The ring is the rectus sheath and the muscle.

other organs on the same or opposite side of the body.

The age factor as well as prostatic enlargement are of great importance in the



FIG. 5. Saddle-bag hernia, showing two sacs; the smaller one is the bladder.

#### ETIOLOGY

Bladder herniation is more frequent in men and in both sexes shows a distinct

formation of the hernial disability. Arduous work or a chronic cough over a long period of time, aggravated by severe bodily strains, are additive and significant factors. Asthenia, following long illness, is another predisposing cause.

Aside from the ordinary causes, there are intrinsic changes in the bladder musculature, with increased urinary pressure due to urethral or prostatic obstruction. A condition of permanent vesical distention may exist with a consequent modification of the normal anatomic relationship of the bladder. The organ is thus brought into direct contact with the inguinal fossa. The vesical wall then becomes attenuated.

There is, as a rule, a history of a long-standing, large, irreducible hernia which perceptibly diminishes in size after urination or catheterization.

The herniation may occur through the inguinal or femoral rings and sometimes, as aforementioned, through the obturator foramen or other apertures.

#### SYMPTOMS

Urinary symptoms, oddly enough, are not always characteristic features of bladder herniation. If urinary symptoms are



FIG. 6. Bilateral recurrent inguinal hernia. At operation right side was repaired. There was a "recurrent" bladder hernia.

predilection for the right groin. The condition may be associated with a hernia of

present (dysuria, frequent or infrequent urination, and unusual tenderness over the protrusion), they are usually due to complications. The patient urinates at inter-

The severity of the symptoms manifestly depends on whether or not there is an associated strangulation, obstruction or other complications.

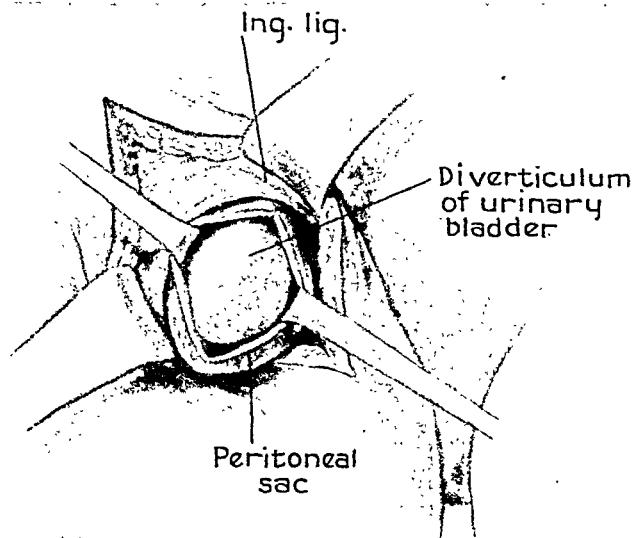


FIG. 7. Bladder protrusion in femoral canal.

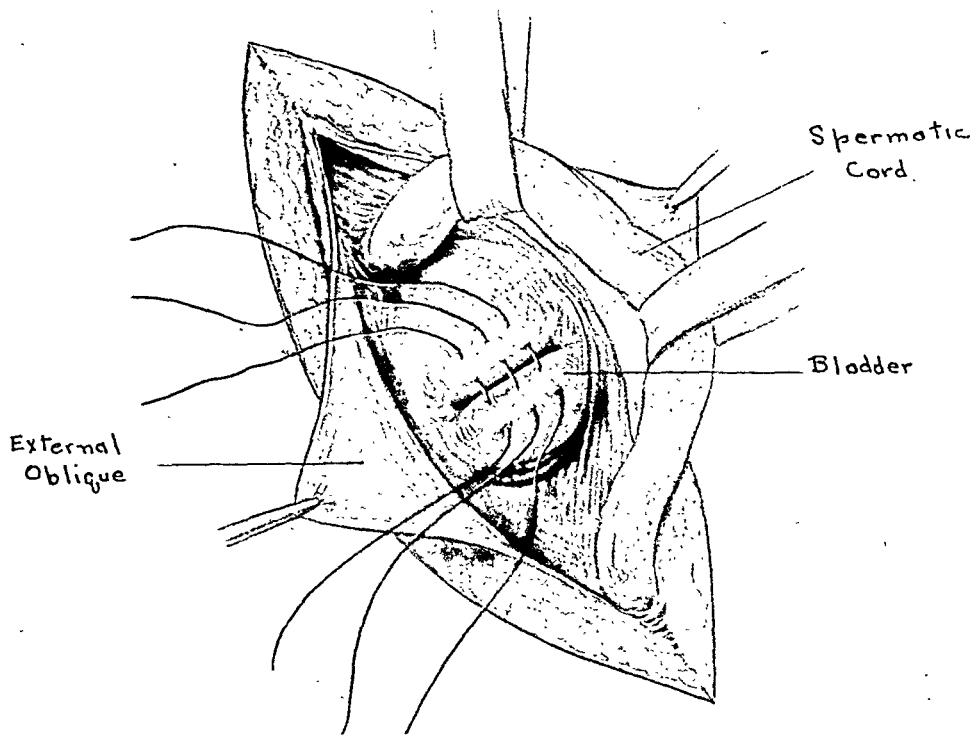


FIG. 8. Reducing redundancy in bladder wall; former method of repairing bladder hernia.

vals, or only when he assumes a certain position or presses on the tumor mass. The last named indication is highly suggestive of the condition. The gastrointestinal symptoms are mainly of reflex nature.

#### DIAGNOSIS

The diagnosis is not always an easy matter. In fact, it is seldom made presurgically. The condition is strongly presum-

tive if there is a history of a long-standing, partly or wholly irreducible inguinal hernia in a patient past fifty. The mass is usually

raphies are advisable for all patients past fifty years of age with inguinal or femoral hernia.

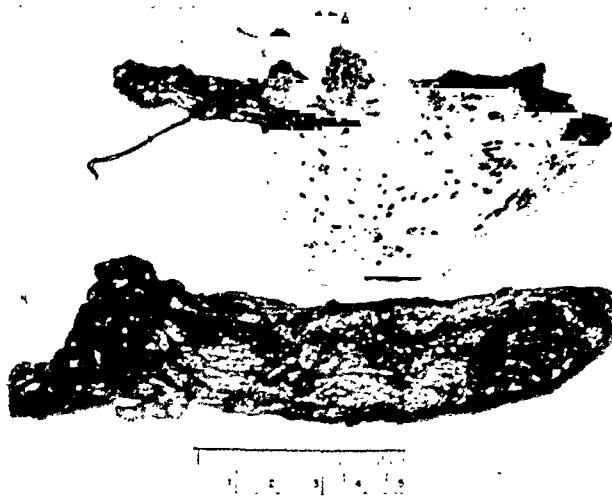


FIG. 9. Exsected portions of a saddle-bag hernia. The upper specimen is a segment of the bladder which formed the medial protrusion through Hesselbach's triangle. The lower one is the lateral part of the hernia, the peritoneal protrusion.



FIG. 10. Bladder protrusion has been resected ready for closure.

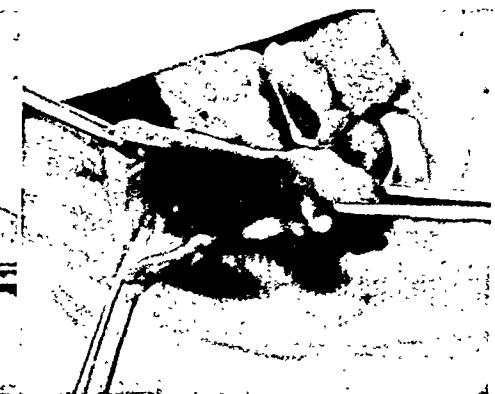


FIG. 11. Another case after resection of bladder protrusion.

flat to percussion. There may be an impulse on coughing. The muscular and aponeurotic structures are thin and attenuated. The subcutaneous inguinal ring is so enlarged that it is frequently impossible to determine contour or size.

In incomplete protrusion, the differential diagnosis must rest mainly between herniation of the bladder wall proper through the inguinal (or femoral) ring, and a true vesical diverticulum passing toward the pelvic floor. Routine cystog-

A cystoscopic and roentgenographic examination will furnish revealing evidence of value. A vesical defect or protrusion on the side corresponding to the hernia will be observed and confirmed by cystography. When catheterization is resorted to, it will prove to be an important diagnostic aid because the mass will disappear; and if a decrease in the size of the swelling follows the flow of urine, the presumptive diagnosis of bladder herniation becomes a certainty. The phenomenon can be demon-

strated in a reverse manner on injecting fluid or air into the bladder.

#### TREATMENT

In a recent article I reported eighty cases of pedicle fascia lata flap repair of difficult

most surgeons to repair the hernia in the accepted manner and to cover the bladder protrusion by reinforcing it with the overlying musculo-aponeurotic structures (Wyllis Andrew, Halsted or Bloodgood technic).

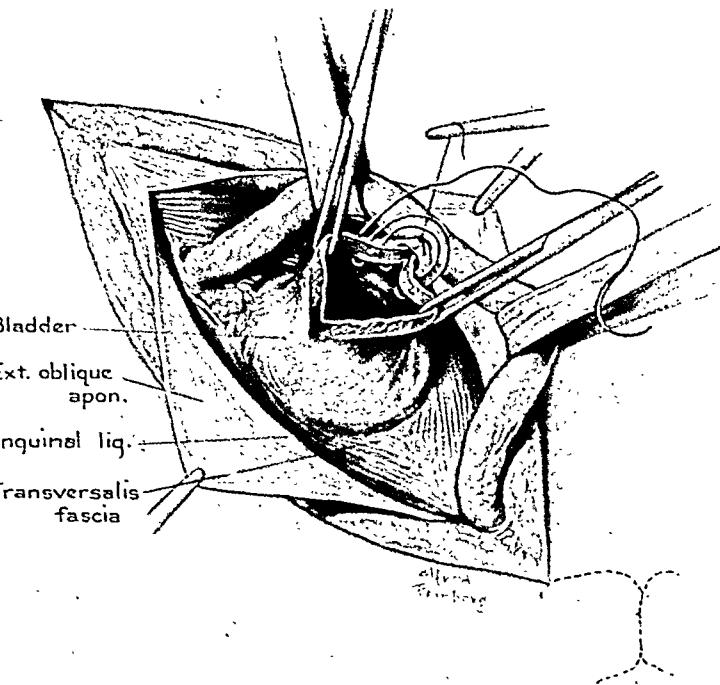


FIG. 12. Closing bladder with Connell suture, after excision of herniated part.

hernias. I re-operated on the few that recurred and found that the bladder protrusion was responsible for the recurrence which occurred in the medial aspect of the inguinal triangle. I corrected this condition in the manner described below with excellent results.

During the surgical repair it is well to be extremely circumspect regarding: (1) An *undue collection of adipose tissue* and tissue simulating adipose tissue adjacent or contiguous to the hernial protrusion, but commonly medial to the sac. (2) *Isolation of the sac*, which will not, as a rule, prove easy. (3) The *dimensions of the hernia*. It is likely to be extremely large or massive, protruding from preternaturally large rings. (4) *Location*. Urinary bladder hernias ordinarily are found closer to the medial abdominal line than other varieties.

In the past it has been customary with

I have been in the habit of eliminating the bladder redundancy by either a double purse-string inversion or by a double layer of interrupted Lembert sutures, and then followed the ordinary technic for a direct or indirect inguinal hernia. (Fig. 8.) However, there have been too many recurrences of the bladder protrusion in all of the five varieties previously mentioned. I have, therefore, devised the following procedure:

The repair of the bladder hernia is the same in the five varieties. In the second variety, the small, indirect hernial sac must be removed first, prior to the repair of the bladder protrusion. In this sequence there is no danger of contamination because the bladder has been not only completely emptied by catheterization at least twenty-four hours before the surgical intervention, but irrigated several times with a weak antiseptic solution. The catheter is not

removed until seventy-two hours after the operation. In the third variety, traction is made on the indirect component

encroachment on its wall and to avoid puncturing the bladder in the transfixion of the indirect hernial sac. (Fig. 9.) The

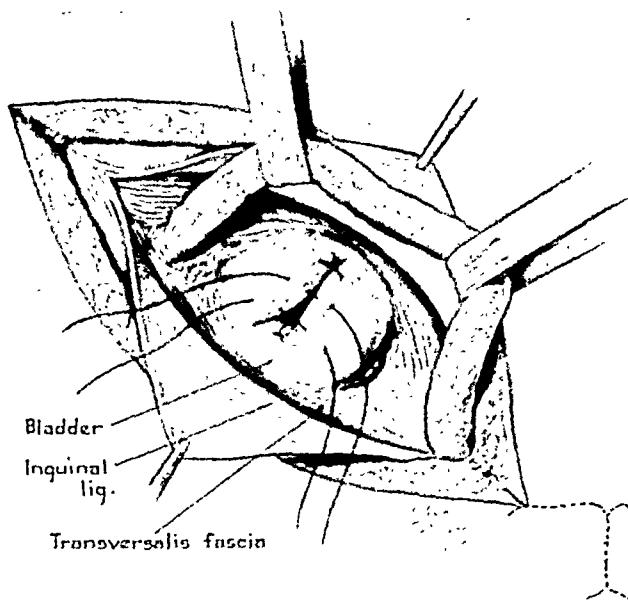


FIG. 13. Re-enforcement with interrupted Lembert sutures.

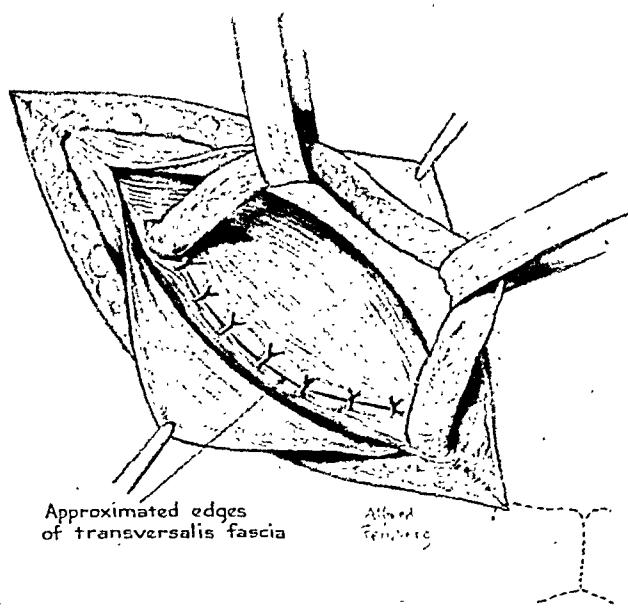


FIG. 14. Approximation of edges of transversalis fascia with interrupted sutures.

of the sac (as in the repair of all saddlebag hernias). The bladder protrusion is partly displaced medially; the indirect hernial sac is opened so as to visualize the extent of

following technic is then used for the repair of the vesical hernia:

The base of the diverticular protrusion is caught by several Allis clamps and the

redundant part excised. (Figs. 10 and 11.) After establishing hemostasis, the edges of the stoma are inverted by means of a Connell stitch, which is reinforced with interrupted Lembert sutures, utilizing No. 0 chromic catgut on an atraumatic needle. (Figs. 12 and 13.) The margins of the transversalis fascia are then approximated and sutured with interrupted strands of No. 0 chromic catgut. (Fig. 14.) The hernial repair is then continued with the utilization of one of the technics commonly acceptable in the repair of direct inguinal hernia.

Digital exploration of the bladder cavity may be done and closure is then accomplished after a change of gloves.

About 5 Gm. of sulfanilamide powder are insufflated in the wounds before closure of the skin.

The catheter (No. 16 French, soft rubber) remains *in situ* for seventy-two hours. It is sterilized and re-introduced for another twelve hours.

The bladder may be irrigated daily with a warm sterile solution of boric acid followed by instillation of 3 dr. of a 2 per cent solution of mercurochrome.

There have been no recurrences in my series of thirty-seven cases. There was one wound infection, and no urinary extravasation in the surgical area.

Spinal anesthesia was used in all cases.

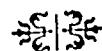
TABLE I

	No.	Aver- age Age	Side	Recurrences One Year Later
Group 1.....	8	50	5 Right 3 Left	0
Group 2.....	8	55	5 Right 3 Left	0
Group 3.....	15	59	9 Right 6 Left	0
Group 4.....	5	56	5 Right	0
Group 5.....	1	49	Right	0
Total.....	37			

One wound infection in Group 3; two cases of mild cystitis in Group 3; one of Group 1 was a female; one case in Group 5 was a female.

#### REFERENCES

1. JABOULAY and VILLARD. Des hernies inguinales et crurales de la vessie. *Lyon med.*, 1895.
2. H. EGGENBERGER. Harnblasenbrüche. *Deutsche Ztschr. f. Chir.*, 94: 524-579, 1908.
3. IASON, A. H. Indirect inguinal hernia. *Am. J. Surg.*, 7: 757, 1929.
4. IASON, A. H. Recurrences following inguinal hernioplasties. *Am. J. Surg.*, 27: 208-276, 1935.
5. IASON, A. H. Hernia. Philadelphia, 1941. The Blakiston Co.
6. IASON, A. H. Fascia lata transplant for difficult hernias. *Surgery*, 13: 511, 1943.



# MALIGNANT TUMORS OF THE STOMACH\*

FELIX DE AMESTI, M.D.

Professor of Surgery, University of Santiago

SANTIAGO, CHILE

**I**N a period of four years, from June, 1938, to June, 1942, 127 individuals having malignant gastric tumors were attended on Surgical Section "B" of the Hospital del Salvador in Santiago, Chile. The diagnosis of gastric carcinoma either was made on our service, or the patient had been transferred with this diagnosis from the Medical Section of Professor Alessandri of the same hospital, or from some other hospital or clinic in the Capital or Province.

One hundred four patients (81.88 per cent) were subjected to operation. Fifty eight of these operations (55.76 per cent) resulted in gastric resection. Seven patients were considered inoperable and sixteen refused operation. In 98.55 per cent the microscopic examination showed carcinoma whereas in 1.44 per cent lymphosarcoma occurred.

The following chart reveals the relation of age to gastric cancer, also the distribution according to sex. We found 74 per cent in male, and 26 per cent in female patients.

TABLE I  
AGE AND SEX DISTRIBUTION

Age	Female	Male	Total
20 to 30.....	1	3	4
31 to 40.....	6	10	16
41 to 50.....	10	25	35
51 to 60.....	9	31	40
61 to 70.....	7	24	31
71 to 80.....	1	0	1
Per cent.....	34	93	127
	26	74	100

In the female the greatest frequency of carcinoma is in the fourth and fifth decade.

In the male it is in the fifth and sixth decade. That is, in men the disease occurs at a later age than in women.

## SYMPTOMATOLOGY

The symptoms which present themselves in patients with gastric cancer are varied, but are of great importance in establishing an early diagnosis and in consequence the institution of radical treatment. The time of evolution, from the onset to the diagnosis on the admission to the hospital, varies from one month to more than two years.

We have classified the symptomatology of our patients and have divided them into five types:

TABLE II  
SYMPTOMATOLOGY

	No. Patients	Per Cent	Resections		Inoperable	
	No.	Per Cent	No.	Per Cent	No.	Per Cent
Dyspepsia.....	73	57.49	35	48.05	28	38.47
Ulcer syndrome.....	32	25.19	14	43.75	16	50.
Hemorrhage.....	6	4.74	3	50.	3	50.
Obstruction.....	9	7.24	3	33.33	6	66.66
Emaciation; asthenia.....	7	5.51	3	45.	3	45.

These groupings were made according to the symptoms at the onset, but since frequently one type is superimposed on the other or is altered periodically, the patients usually arrive at the hospital with all the symptoms combined.

The most frequent type is the dyspeptic, in more than half of the cases, followed by the ulcerous type in 25 per cent. Hemorrhage as a first symptom occurred in six patients (4.74 per cent) and pyloric or cardiac obstruction in nine (7.24 per cent). Emaciation and asthenia were the initial findings in seven patients (5.51 per cent).

\* Address given before the Staff of the Memorial Hospital of New York.

In the evolution of the disease emaciation ultimately was present in 99 per cent of the patients.

In respect to the time interval between the onset of the symptoms and admission to the hospital we have divided the group in the following manner:

globular and hemoglobin count in 15.88 per cent.

A history of heredity or possible familial influence was found in twenty-two patients; 15.74 per cent were paternal and 1.57 per cent from other relatives.

*Gastric analyses* were performed in eighty-

TABLE III  
RELATION OF OPERABILITY TO DURATION OF SYMPTOMS

	Patients	Per Cent	Inoperable	Per Cent	Operable	Per Cent
1 to 2 months.....	30	23.62	10	33.33	15	50
4 to 5 months.....	41	32.28	23	56.09	16	39.02
8 to 11 months.....	15	11.81	6	40	6	40
1 to 2 years.....	34	26.77	11	32.35	18	52.93
More than 2 years.....	7	5.51	3	42.85	3	42.85
	127	.....	53	.....	58 (and 16 refused operation)	

In reviewing the relation between the operability of the tumor and the duration of the disease, we can see that the patients in whom the evolution of symptoms has been present for more than a year possess a greater operative possibility. The explanation of this paradox may be that the cancer is less malignant, in consequence of which evolution is retarded. In the patients who apply for treatment within one to three months of the date of onset, or perhaps his discomforts have caused him to go for an early diagnosis, notwithstanding the more or less rapid growth of his neoplasm, it may be that chance has caused him to arrive at the opportune moment for resection.

TABLE IV  
RESULTS OF GASTRIC ANALYSIS

		Per Cent
Anachlorhydria.....	64 patients	77.10
Hypochlorhydria.....	14 patients	16.86
Isochlorhydria.....	4 patients	4.81
Hyperchlorhydria.....	1 patient	1.20

Anemia of distinct intensity was present in 84.12 per cent there being a normal

three cases with the result shown in Table IV.

#### X-RAY DIAGNOSIS

X-ray examinations were done on 116 cases; in some of the remaining cases it was

TABLE V  
RADIOLOGICAL EXAMINATIONS ON 116 PATIENTS WITH  
GASTRIC CANCER

		Per Cent
Diagnosis of gastric cancer.....	109	93.96
Diagnosis of gastric ulcers.....	2	1.72
Diagnosis of degenerated gastric ulcers..	1	0.86
Diagnosis of pyloric stenosis.....	2	1.72
Diagnosis of gastric tumor.....	1	0.86
Diagnosis of organic pyloric lesion.....	1	0.86

not done due to gastric stasis or obstruction or because of established gastroscopic diagnoses or for causes inherent to the service. In these 116 patients gastric cancer was indicated in 109, two were diagnosed as gastric ulcers, one as a degenerated gastric ulcer, two were classified as pyloric stenosis without specification as to cancer and one was diagnosed as a possible benign gastric tumor. In four patients a diagnosis of

cancer was not made at the first examination, but was confirmed in the second examination following gastroscopic diagnosis of cancer.

The value of roentgenological examination is of great importance. It permitted the diagnosis of gastric cancer in 96.55 per cent of cases, counting the four diagnoses made after gastroscopic examination. In these "gastric lesions" 85.34 per cent were specifically cancer and in the balance of the cases diagnosis of cancer was confirmed by gastroscopic examination, gastric analysis and the clinical picture.

#### GASTROSCOPIC DIAGNOSIS

Gastroscopic examination was done on forty-nine of the 127 patients with gastric cancer. The diagnosis of cancer was made in forty-six instances. In thirty-seven patients the diagnosis of associated atrophic gastritis was made which was also confirmed by histological examination. One case was diagnosed as slight superficial gastritis without having been able to visualize the antrum and pylorus where the carcinomatous lesion was; and in one case the diagnosis of polyposis and atrophic gastritis was made. In summary, the diagnostic value of this examination is very good since in our patients the margin of error was only 4.08 per cent and a certain diagnosis was arrived at in 95.92 per cent.

**Localization.** In determining the location of the gastric cancer in our patients we have taken into consideration the anatomic-pathological examination of the operated patients and autopsies, and the gastroscopic and radiological examinations in the remainder. The most frequent location was on the lesser curvature—29.75 per cent; in the antropyloric region 29 per cent; advanced infiltration of the entire stomach, 19.20 per cent; in the cardiac end 8.26 per cent; in the pylorus exclusively 4.13 per cent; on the greater curvature 1.65 per cent; and in the corpus 2.47 per cent.

**Treatment and Results.** In the period of four years from June, 1938, to June, 1942,

we have treated on our service 127 patients with a diagnosis of gastric cancer with an operability of 81.88 per cent. Taking into account the seven patients considered inoperable and sixteen who refused operation, the resectability was 55.76 per cent including nine total gastrectomies.

The exploratory and palliative operations were performed because of the impossibility of doing a resection due to hepatic metastasis or extensiveness or immobility, due to adhesions of the tumor to other organs or due to its growth into the surrounding structures.

In the following chart we make note of the operations performed, the percentage of operability, the number of deaths in each intervention, and the percentage of deaths.

TABLE VI  
OPERABILITY AND MORTALITY RATES

Operation	No.	Operability, Per Cent	Deaths	Mortality, Per Cent
Subtotal gastrectomies	49	47.11	8	16.32
Total gastrectomies . . .	9	8.65	4	44.44
Gastric resections . . .	58	55.76	12	20.68
Gastroenterostomies . . .	12	10.57	3	25.
Exploratory laparotomy . . .	25	24.03	0	0
Jejunostomies . . .	6	5.76	2	33.33
Intestinal resection . . .	2	1.92	1	50.
Gastrostomy . . .	1	0.96	0	0
Operations . . .	104		18	17.30
Refused operation . . .	16			
Inoperable . . .	7			

The total mortality on the service was 15.74 per cent; the postoperative mortality 17.30 per cent.

The operative resectability was 55.76 per cent. This corresponds to 45.7 per cent of all the patients with gastric cancer seen during this period.

Total gastrectomies comprised 15.09 per cent of all the resections for carcinoma. A comparative study of age and mortality of the patients operated upon indicates

that the greater the age the greater the mortality and that operative risks lessen in the young.

TABLE VII  
RELATION OF AGE TO MORTALITY RATES

Age	No. of Patients	Death	Mortality, Per Cent
20 to 30.....	4	0	0
31 to 40.....	13	2	15.40
41 to 50.....	24	5	16.67
51 to 60.....	29	5	17.24
61 to 70.....	34	7	20.59

The mortality of the gastrectomies is in direct relation to the difficulty of the operation, since the greater the operative risk the greater the mortality. To arrive at this conclusion we have divided the subtotal gastrectomies into difficult and non-difficult cases, taking into account in the first group the difficulty of resection, i.e., adhesions to the surrounding organs, the penetration of the tumor into the intestine and the necessity to resect it, the amplitude of the gastrectomy, the physical unfitness of the patient, etc. These things which lengthen the time of operation diminish the chances of survival.

TABLE VIII  
RELATION OF OPERATIVE DIFFICULTY TO MORTALITY RATES

	No.	Deaths	Mortality, Per Cent
Difficult subtotal gastrectomies.....	17	7	41.17
Non-difficult subtotal gastrectomies.....	32	1	3.12

The most frequently used anesthetic was  $\frac{1}{2}$  per cent novocain local infiltration; on some occasions 1 per cent novocain was added with satisfactory results in most cases; preoperative medication was always used. In some patients unable to stand the operation under local anesthesia, it was

supplemented by cyclopropane. We noted that the amount of cyclopropane was less than when used without novocain and

TABLE IX  
ANESTHESIAS EMPLOYED

	No.	Percentage
Gastrectomies		
Local novocain.....	20	37.04
Local and cyclopropane.....	10	18.52
Spinal procain.....	9	16.67
Cyclopropane.....	7	12.96
Local and anterior splanchnic.....	4	7.40
Cyclopropane and ether.....	3	5.65
Ether.....	1	1.85
Exploratory Laparotomies		
Local novocain.....	13	52
Local and cyclopropane.....	2	8
Spinal procain.....	3	12
Cyclopropane.....	5	20
Local and anterior splanchnic.....	2	8
Gastroenterostomies		
Local novocain.....	7	58.33
Local and cyclopropane.....	2	16.67
Spinal procain.....	1	8.33
Cyclopropane.....	2	16.67
Jejunostomies		
Local novocain.....	5	83.33
Spinal procain.....	1	16.67
Gastrostomies		
Local novocain.....	1	100
Exclusion Resection		
Local novocain.....	1	100

afforded better muscular relaxation and less waste of cyclopropane, also less toxic to the patient.

The most frequent postoperative complications are of respiratory origin ranging from a simple bronchitis to pneumonia and bronchopneumonia. Lately respiratory complications have diminished due to the

use of the sulfa drugs which were used at first as a curative measure and then as a preventative, beginning its use twenty-

TABLE X  
POSTOPERATIVE COMPLICATIONS

	No.	Per- centage
Gastrectomies		
Respiratory.....	9	40.90
Infections of the wound.....	4	18.18
Cardiac.....	2	9.09
Peritonitis.....	2	9.09
Shock operative.....	2	9.09
Jaundice.....	2	9.09
Gastric fistula.....	1	4.54
Postoperative complications in gas- trectomies.....	22	37.93
Exploratory Laparotomy		
Respiratory.....	2	66.66
Thrombophlebitis of lower limbs.....	1	33.33
Complications postexploratory lap- arotomy.....	3	12.
Gastroenterostomy		
Respiratory.....	1	33.33
Diarrhea.....	1	33.33
Shock.....	1	33.33
Postoperative complications in gas- troenterostomies.....	3	25
Jejunostomy		
Respiratory.....	1	100
Postoperative complications in jejunostomies.....	1	16.66
Exclusion Resections		
Respiratory.....	1	100
Postoperative complications in ex- clusion resections.....	1	50

four to forty-eight hours before operation and continuing for from three to four days postoperatively. The drug is discontinued when the temperature is no longer elevated.

The same medication diminishes the number of wound infections, also the frequency of peritonitis. In the last year postoperative pneumonia has practically disappeared. We had only one case in which the sulfa drug was omitted, which corroborates the necessity for its routine use in patients with gastric cancer who are scheduled for the operating room.

#### HISTOPATHOLOGICAL EXAMINATION

The histological examinations performed in the service of Surgical Pathology of this hospital gave the following results:

TABLE XI  
HISTOLOGICAL TYPES

	No.	Per- centage
Adenocarcinoma.....	37	53.62
Mixed cell carcinoma.....	12	17.39
Solid carcinoma.....	12	17.39
Gelatinous carcinoma.....	3	4.34
Schirrhous carcinoma.....	2	2.89
Degenerated ulcers (adenocarcinoma).....	2	2.89
Lymphosarcoma.....	1	1.44

The pathological examination is of great importance in recognizing the histological type and the evidence of metastasis in the lymph nodes since this gives us the prognosis, because if it is a sarcoma we know that radiotherapy is indicated and that if there are no lymphatic metastases in a carcinoma the prognosis is more favorable. For this reason we have divided the distinct histological types with respect to lymphatic metastases in Table XII.

According to the Borrmann classification the results are as shown in Table XIII.

We find the greatest frequency in carcinoma in Type II Borrmann followed by Type IV, having the lowest percentage in Type I.

Of the inoperable carcinoma in which a histological examination by biopsy was done we found eleven adenocarcinomas, one solid carcinoma, one mixed cell carcinoma.

TABLE XII  
RELATION OF HISTOLOGICAL TYPE TO LYMPHATIC METASTASES

Without Lymph Node Metastasis	With Lymph Node Metastasis	Examination Did Not Specify
Adenocarcinoma and catarrhal lymphadenitis.....	Adenosarcoma metastasis in lymph node.....	Adenocarcinoma.....
Mixed cell carcinoma and catarrhal lymphadenitis.....	Mixed cell carcinoma and lymphatic metastasis.....	Mixed cell carcinoma.....
Solid carcinoma & catarrhal lymphadenitis.....	Solid carcinoma and metastasis to lymph nodes.....	Solid carcinoma.....
Gelatinous carcinoma and catarrhal lymphadenitis.....	Gelatinous carcinoma and metastasis to lymph nodes.....	Gelatinous carcinoma.....
Scirrhous carcinoma and catarrhal lymphadenitis.....	Scirrhous carcinoma and metastasis to lymph nodes.....	
Degenerated ulcer (Adenocarcinoma) and lymphadenitis.....	Degenerated ulcer (adenocarcinoma) and lymphatic metastasis.....	
12 cases with catarrhal lymphadenitis..... 21.05 per cent	45 cases with lymph node metastasis.. 78.94 per cent	

The relation between the duration of symptoms and the histological type are as shown in Table XIV.

TABLE XIII  
BORRMANN CLASSIFICATION

Group	No.	Percentage
I	3	5.88
II	19	37.25
III	11	20.52
IV	18	35.29

By the preceding picture we can deduct that the mixed cell carcinoma is slower of evolution because the majority of patients arrive at the hospital later; adenocarcinoma follows, solid carcinoma being the most rapid in progress. Hence the majority of these patients arrive before three months

have elapsed since the onset of symptoms. What has been said previously confirms the relation of the time between the onset in inoperable carcinoma and the histological examination.

We see that the inoperable carcinoma with the shortest time of development was the solid, followed by the adenocarcinoma, the mixed being the slowest.

#### PROGNOSIS

We consider the prognosis in those individuals who did not die postoperatively allowing a postoperative period of thirty days. This prognosis varies with each intervention for which reason we shall view them separately. The greatest difficulty in the region of our hospital is the control of postoperative follow-up. Of our total patients, 36.43 per cent of those

TABLE XIV  
RELATION OF HISTOLOGICAL TYPES TO DURATION OF SYMPTOMS IN OPERABLE CARCINOMAS

Duration of Pain	Adenocarcinoma	Solid	Mixed	Gelatinous	Scirrhous	Lymphosarcoma
1 to 3 months.....	9	6	1	..	1	1
4 to 6 months.....	11	3	2			
7 to 12 months.....	6	2	5	2	1	
13 to 24 months.....	6	1	1	1		
More than 24 months.....	2	1	3			

treated on this service in four years have kept us informed as to their state of health. Of the gastric resections we have been able to do a postoperative follow-up on 55.17 per cent.

TABLE XV  
RELATION OF HISTOLOGICAL TYPE TO DURATION OF SYMPTOMS IN INOPERABLE CARCINOMA

Duration	Adeno-carcinoma	Solid	Mixed
1 to 3 months.....	..	1	
4 to 6 months.....	7		
7 to 12 months.....	4		
More than 12 months.....	..	..	1

The patients who had total gastrectomies had an average postoperative life of six months. Only one is alive and in good condition fourteen months after the operation.

The subtotal gastrectomies have an average life of seven and one-half months, aside from those who actually live amounting to 28.57 per cent.

More than 4 years.....	1 patient
More than 2 years.....	2 patients
More than one year.....	2 patients
6 to 11 months.....	4 patients
1 to 6 months.....	5 patients

Average survival....	Gastroenterostomies	2½ months
Average survival....	Exploratory laparotomies	4 months
Average survival....	Gastrostomies	2 months
Average survival....	Jejunostomy	1 month
Average survival....	Inoperable	2 months

The longest survivals in patients with gastric cancer, aside from the resections, were those who underwent exploratory laparotomy. They averaged four months of postoperative life while the palliative operations such as gastroenterostomy, gastrostomy, jejunostomy, etc., averaged two months. Therefore, in gastric cancer if it is not possible to perform a radical operation such as a gastrectomy only an exploratory laparotomy should be done since it is the only one that prolongs life.

The gastrectomies with an average survival of seven and one-half months showed

the existence of lymph node metastases in all but two cases which indicated catarrhal lymphadenitis.

Of the patients who had gastrectomy for cancer and who actually survive with a diagnosis of only catarrhal lymphadenitis in the perigastric one has lived four years, one has lived two years, and one is living two months later. In the remainder the histological examination showed metastasis to regional lymph nodes.

#### RELATIONSHIP OF THE OPERABILITY OF GASTRIC CANCER TO THE INTEGRITY OF THE HEART AND VASCULAR SYSTEM

Out of the 127 patients treated for gastric cancer four had cardiac lesions with cardiac insufficiency which, under treatment, became compensated prior to the operation. The operation was then performed without difficulty. Two days before the operation all of these patients received  $\frac{1}{4}$  mg. of estrosantina daily which treatment was continued for three or four days postoperatively. In the following chart we make note of the different diagnoses, operations, anesthesias employed, and the prognosis.

#### BENEFIT OF GASTRECTOMY IN PATIENTS HAVING GASTRIC CANCER WITH AN AVERAGE LIFE OF SEVEN MONTHS

Of the patients who died several months after a gastrectomy, eighteen continued to have symptoms of their illness which did not permit the patients to resume their normal activity, or 50 per cent. The other 50 per cent were able to resume an active life although in some cases for as short a period as one to two months, and others for one year until the symptoms returned and the patient died. Two patients (11.11 per cent) returned to their activities and died from other causes than gastric cancer, cardiac insufficiency having caused their deaths.

#### SUMMARY

1. In the four years that we have been attending 127 patients with gastric cancer,

84 per cent of the total were seen in the last two years, due to the recognition of the specialization of this matter on this service.

gastrectomies and 44 per cent in total gastrectomies.

7. The operative mortality increases in

TABLE XVI  
GASTRECTOMY IN PATIENTS WITH HEART DISEASE

No. of Observation	Age	Diagnosis	Operation	Anesthetic	Prognosis
37-1950	65-A	Gastric cancer—aortic insufficiency; arteriosclerosis	Subtotal gastrectomy	Local novocain	Died, 8th day, peritonitis
39-8721	58-A	Gastric cancer; hypertension; low pulse pressure; rheumatic mitral insufficiency	Subtotal gastrectomy	Local novocain	Died, two months. No metastases; cardiac insufficiency
39-5521	41-A	Gastric cancer—aortitis—aortic insufficiency (Hodson)	Subtotal gastrectomy	Local novocain	Died, 4 months; cardiac insufficiency; no metastases
40-8471	55-A	Gastric cancer; aortic insufficiency; luetic aortitis	Total gastrectomy	Local splanchnic	Died, 7 months; right pleural metastases; carcinomatous peritonitis

2. We have observed the greater frequency of gastric cancer in the masculine sex (74 per cent) and in the fifth decade of life.

3. The presence of dyspeptic symptoms (57 per cent) or the ulcer syndrome (25 per cent) in individuals over forty years and without previous digestive disturbance should lead us to suspect gastric cancer.

4. The gastric resectability is greater (52 per cent) in individuals whose symptoms are of one year's duration than in those patients with shorter histories, since they are tumors of slow evolution.

5. The lesser curvature and prepylorus are the regions in which gastric cancer localizes more frequently. They interfere with the flow of gastric juice, producing anachlorhydria or else the cancer spreads itself into previously degenerated mucosa (chronic gastritis).

6. Gastric resectability is one of the highest of those published (55.76 per cent) with a mortality of 20 per cent corresponding to a 16 per cent in subtotal

direct relation with the age and the difficulty of the operation.

8. The most frequent postoperative complications are: respiratory and wound infections, whose percentage has diminished notably since the routine use of the sulfanilamides.

9. The evolution of gastric cancer is in possible relation with its histological type; the slowest evolution has been the mixed cell cancers followed by adenocarcinoma. The solid cancers are the most rapid in growth.

10. The prognosis is better for exploratory laparotomy than for the palliative operations, i.e., gastroenterostomy, jejunostomy, gastrostomy, etc.

11. The gastrectomies were executed without difficulty in four patients with severe cardiac difficulties, one of which was a total gastrectomy with equal good evolution postoperatively, as easily as in an individual with normal cardiac function.

12. The only treatment in gastric cancer is radical gastrectomy performed at an opportune time.

# SUBMUSCLE PELVIC TISSUE SPACES

## ANATOMY AND CLINICAL CONSIDERATIONS

CAPTAIN BEN H. BRUNKOW\*

Medical Corps, Army of the United States

MONROE, WISCONSIN

THE anatomy of fascial spaces, muscles, the retroperitoneal space and the pelvis in general is a "bug-bear" for the medical student and this dilemma is not clarified in the mind of the practitioner as the years separate him from the dissecting room. It is the author's belief that this general hazy conception of these structures is due to the lack of a clear knowledge of the embryological development of these areas, plus a lack of correlation of this knowledge with parts such as the anterior abdominal wall where the anatomy is well understood. This paper is written to show this correlation and to give some surgical applications of the same.

The ventral and caudal ends of the embryo are formed during the first two weeks of fetal life. At the time of formation of the embryonic disc the three primitive tissue layers are present, i.e., ectoderm, mesoderm and entoderm. From the embryonic disc all the bodily structures are formed. Growth proceeds from this flat structure in all directions. Some parts show more rapid growth than others; there are out-growths and in-growths here and there, but in general there is an outward and downward growth meeting in the midline ventrally to form the abdominal wall. This general plan may best be visualized by comparing the embryo at this early stage to a sealed envelope. The address side represents the embryonic disc area with growth extending out and down in all directions, the ventral part coming together by four flaps, one at each end and one on each side. The side flaps may be considered to form the abdominal wall. The cephalic flap is

not very distinct in the fully developed embryo but may be considered, for analogy at least, to be represented by the fascial and superficial neck muscle, the pectoralis muscles and the rectae muscles of the abdominal wall. The caudal flap forms the caudal or rectogenital end of the body. The clear conception of this picture of development is essential for the correlation and remembering of the pelvic structures in their proper relationship.

These flaps grow in all directions and are made up of their three primitive germ layers. Nothing will be said about the ectoderm as this becomes visible and easily understood. The mesoderm forms the subcutaneous tissue, fat, muscles and fascia. On the abdominal wall this layer is represented by subcutaneous tissue, external and internal oblique and the transversalis muscles, the submuscular layer of loose areolar tissue known as the transversalis fascia and peritoneum. This later will be referred to hereafter as the submuscle tissue layer. For simplicity and clarity the above three muscle layers will be considered as one mass. This gives five definite layers, i.e., skin, subcutaneous tissue, muscle, submuscle tissue layer and peritoneum. It should be noted here that the submuscle tissue layer extends posteriorly to the spinal column. It is within this tissue that the retroperitoneal structures such as pancreas, kidneys and ureters lie. Garota's fascia is a specialized portion of this tissue enveloping the kidneys.

The same layers are present in the caudal flap. Here the muscle layer is represented by the levator ani, compressor urethrae

\* Dr. Brunkow was on the Staffs of St. Vincent's and Billings Deaconess Hospitals, Billings, Montana, previous to his enlistment with the Armed Forces.

and the muscles in the skin and subcutaneous tissue, i.e., dartos, perineal and the sphincter muscle. It is these muscles, especially the former, that cause so much distress and confusion in the mind of the student and physician.

Phylogenetically, the levator ani muscle has served several functions. In the fish and salamander group of animals this muscle flexes the tail producing the main means of locomotion and protection. In the mammals, such as the cow and the horse, the levator ani is a fairly strong muscle and flexes the tail from side to side principally for protection against insects. In man this muscle loses its tail swinging properties. Instead by a more direct ventral attachment to the pubis and the sacrum it forms a sling-like structure which on contracting attempts to shorten the distance between these two immovable points thereby forming a solid band or floor for the pelvis. The rectum and urogenital sinus pierce this muscle in the midline forming potentially two round orifices. By attachment at each end and to a central point, the superficial perineal muscle forms a figure-of-eight about these orifices external to the levator ani muscle. This arrangement produces efficient sphincters for both orifices.

Below or internally to the levator muscle, as with the abdominal wall muscle mass, is the submuscle areolar tissue known as the urorectal or urogenitorectal fascia. This fascia is continuous with that over the abdominal wall and occupies a space which in this paper is called the submuscle tissue space. It is spoken of clinically as the retroperitoneal space. Actually there is no space here, this space being taken up by areolar tissue, fat nerves, blood and lymph channels.

This submuscle tissue layer is so important and difficult to comprehend that a more detailed consideration will be given. For this it is desirable to return to the study of the embryo for clarification.

In the 2 mm. embryo the primitive gut lined by entoderm is made up of the yolk sac. It is hardly a sac and had better be

considered a flat mass of cells extending downward from the embryonic disc to meet in the midline where the four envelope-like flaps meet ventrally. Covering this structure is a mass of unidentified cells, the mesoderm. This mass of tissue divides into two major parts, i.e., the outer or muscle forming layers, referred to above, and the inner fascial layer now under discussion. The cell layer bordering on the primitive gut tract forms two layers with a cavity in between the future abdominal cavity, the cells forming the visceral and parietal peritoneum. The primitive gut settles ventrally pulling the peritoneum and the submuscle fascia with it forming the mesentery. It can be seen that the submuscle layer acts as a buffer or cushion between the peritoneum, both visceral and parietal, and the muscle layer.

Early this mesodermic mass has a considerable thickness. As growth proceeds it becomes compressed to a thin tissue, at least the inner portion, in places becoming little more than a potential space. If the student will retain the conception of the gut tract and mesentery as being a flat partition-like structure hanging from the midline and give the inner portion of the mesodermal mass the relative thickness it once had in embryo, he can see it as an organ of considerable size, easy to trace and comprehend. Besides forming the skeletal tissues this mass of cells form the blood vessels, lymph nodes and vessels, the urogenital system and the supporting structures of these tissues. Normally, these structures seemingly do not occupy space but in disease such as inflammatory swellings, abscess ramifications, or neoplasms there is an attempt of varying degrees to restore thickness to this tissue comparable to that of the embryo. For a sound surgical attack on these disease conditions, the surgeon should have the anatomy of this submuscle tissue layer well in mind.

#### SURGICAL CONSIDERATIONS

*Superficial Infections.* A carbuncle or abscess located in the tissue external to the muscles of the abdominal wall usually gives

the surgeon little doubt as to the location of pus and the place of drainage. The depth and ramifications of an abscess in the perineum is not so well understood by the profession in general. Viewed as a part of or similar to the abdominal wall, the anatomy becomes clarified. The much discussed ischiorectal fossa is only a diamond shaped subcutaneous space filled with fat and pierced by the rectum and urogenital tract. The deep wall is formed by the levator ani muscle. Doctor Batson found by actual measurement that this fossa could hold no more than four ounces on a side in the average adult. When an abscess in this area is opened and more than four ounces of pus are obtained it can be assumed that some of the pus is draining from an abscess on the opposite side or deep to the levator ani muscle, i.e., in the submuscle tissue space and that adequate provision should be made for drainage of these areas.

*Deep Infections.* By the term "deep infections" is meant infections deep to the muscle layer. It is the infection of the submuscle tissue layer. It includes such well known entities as retrocecal abscess, subphrenic abscess, abscess of the broad ligament, perinephritic abscess, periprostatic abscess, pelvic cellulitis following trauma and infection such as that following child birth, urinary extravasation from extraperitoneal rupture of the bladder, infection of the space of Retzius and the infiltrating and fibrosing chronic diseases such as lymphopathia venerum. By reviewing the ramifications of the inner portion of the embryonic mesoderm layer one can see that all these clinical entities are infections or abscess in one structure, the names only specifying in what area the disease is located. The extension of inflammation or abscess from one of these areas to the other can be readily understood. By the same review the surgeon knows he must pass through the skin, subcutaneous tissue and a muscle layer and that only, before he can institute drainage.

Certain technics such as the transpleural

posterior approach to a subdiaphragmatic abscess is a departure from the above anatomic simplicity. Abscess, cellulitis or urinary extravasation about the base of the bladder may be drained by an approach to the submuscle tissue space suprapublically, i.e., through the space of Retzius or better through the central part of the perineum, traversing through or between the levator ani muscle into the infected region. Opening a broad ligament abscess through the vagina is essentially the same route as given above only taking advantage of a natural orifice. Another approach to the broad ligament abscess is at the level of the internal ring, following the round ligament retroperitoneally and down into the true pelvis. If desired through-and-through drainage may be instituted from the internal ring to the vagina. Likewise the space of Retzius may be drained suprapublically and/or through an incision in the perineum.

It is not uncommon to find varying amounts of red and white cells in the urine in acute appendicitis. These cases are usually retrocecal appendices and the disorder is appendicitis, periappendicitis, infection of the submuscle tissue or retroperitoneal space, peri ureteritis and ureteritis.

There has been much conjecture and debate on how bacteria from the intestinal tract get from that organ to produce such diseases as pyelitis, cholecystitis, cystitis and other abdominal conditions. If one views the submuscle space as one organ connected throughout by a network of lymph vessels, one can easily understand how once the bacteria have gone through the intestinal wall they might go directly or by reflux to any of the organs in or bordering on this tissue space.

Probably a large number of the so-called referred pain syndromes in and about the abdominal organs could be explained on a more exact pathological basis if one considers that all the visceral nerves and part of the peripheral nerves traverse this submuscle tissue. Lymph drainage from one

diseased area can produce a lymphangitis some distance from the site of the original infection; this in turn produces perineuritis and neuritis and from these give rise to what is termed referred pain. Such conditions probably explain some of the confusing symptoms encountered in diseases of the pelvic organs.

Carcinoma and lymphopathia veneria spread along the lymph channels. In general the lymph channels follow along the blood vessels supplying the organs. One can readily see how these diseases by infiltration and pressure cause obstructive uropathy and stricture of the rectum. To obtain relief from the obstruction the opening in the ureter or bowel must be proximal to the diseased region where the blood and lymph vessels course through the submuscle tissue space.

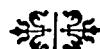
*Pelvic Repair.* Many gynecologists, upon being asked what tissues they use and depend upon for the support and correction of cystocele and rectocele, reply that they suture together the pelvic fascia. On further questioning they cannot give a clear description of this fascia nor from what it was derived. Those who depend upon the "pelvic fascia" to correct cystoceles and rectoceles permanently are doomed to some disappointment.

The submuscle tissue which occupies the submuscle tissue space in general is a loose areolar tissue having varying amounts of fat depending upon the individual and place of the body. In the pelvis it folds

over in areas to form rather weak ligaments and fascia, i.e., the uterosacral, the broad ligament, the uterovesicle ligament in the female, the prostatic capsule and subvesicle ligament in the male, and the so-called pelvic fascia in both sexes. The support of the pelvis and pelvic structures is primarily performed by the levator ani muscle just as the abdominal muscles are the chief support for the anterior abdominal wall. Therefore, in the correction of cystocele and rectocele, the surgeon's prime aim should be to restore to normal the sling-like plane of the levator ani muscle reducing the orifice of the vagina and the rectum to as near slit-like openings as is possible and yet feasible for good function. The figure-of-eight configuration of the superficial muscles about the rectum and vagina should be remembered when an attempt is made to restore this crossed over insertion, when destroyed, in order to restore normal sphincter action.

#### SUMMARY

An effort has been made to correlate the easily understood anatomy of the anterior abdominal wall with the poorly understood anatomy of the pelvis and retroperitoneal space. Once this correlation is understood the student or physician can easily and quickly orient the different layers. Some surgical applications of this knowledge have been presented. As the internist must know his drugs, so must the surgeon know his fascial spaces.



# APPENDICITIS\*

## A REVIEW OF 4,283 CASES

Moses Behrend, M.D.

Attending Surgeon, Jewish and Mt. Sinai Hospitals

PHILADELPHIA, PENNSYLVANIA

THIS paper is based on the experience gained from a series of 4,283 appendectomies compiled from personal office and hospital records. The cases comprise appendectomies performed in the Jewish and Mount Sinai Hospitals from 1913 to January 1, 1942. The series includes operations on the appendix for acute, subacute and chronic lesions. In the above total are included appendectomies done in the course of abdominal operations performed for other conditions.

### CHRONIC APPENDICITIS

There is no question that chronic appendicitis is a distinct clinical entity. Absolute cure of many patients follows the removal of an appendix packed with foreign bodies of all kinds. Fecal concretions constituted the large majority of abnormal bodies found in the appendix, pin worms were not uncommon, seeds, round worms and solid objects were rarely found. Two cases of carcinoid of the appendix were uncovered, as a result of symptoms resembling those of chronic appendicitis. Especially annoying are the symptoms referable to those appendices situated retrocecaally and bound to the posterior wall of the cecum. The u-shaped appendix, so formed by adhesions which bind down the mid-portion of the viscus commonly results in nagging symptoms. Its removal may cause relief from complaint that is often spectacular. Symptoms of chronic appendicitis may occur in children and adults. In children the symptoms are usually due to congenital malposition of the appendix dependent upon non-rotation

of the cecum placing the appendix in a retrocecal position.

### INCIDENTAL REMOVAL OF APPENDIX

The incidental removal of the appendix should almost always be undertaken while operating for other abdominal conditions. I have never had to regret this additional step even in the presence of a ruptured extra-uterine pregnancy. The appendix should be removed when the primary operation is a cholecystectomy except in rare instances.

### ACUTE APPENDICITIS

When the classical symptoms of pain, tenderness and rigidity in the right lower quadrant are present, the diagnosis should not be difficult. There are, however, many variations from this picture which frequently tax one's ability to make a proper diagnosis. In many cases there is a variable amount of discomfort depending upon the stages of the disease. Rigidity may be very marked without much inflammation of the appendix at the time of operation. Conversely, rigidity of the abdomen is often slight especially in fat individuals in whom the appendix is commonly gangrenous. The physical examination is a most reliable means of making a diagnosis. The white blood count, particularly the Schilling modification is of some assistance, but greater reliance must be placed upon the degree of rigidity present. This is frequently difficult to evaluate and accurate diagnosis often depends on a "sixth sense" which is acquired only after one has palpated hundreds of abdomens. The blood

\* From the Services of the Jewish and Mount Sinai Hospitals.

count is undoubtedly helpful, but should be used only as an adjunct in obtaining a diagnosis. The manifestations of appendi-

physician. Drawing up of the leg during palpation of the right iliac fossa is the most important sign of an inflamed ap-

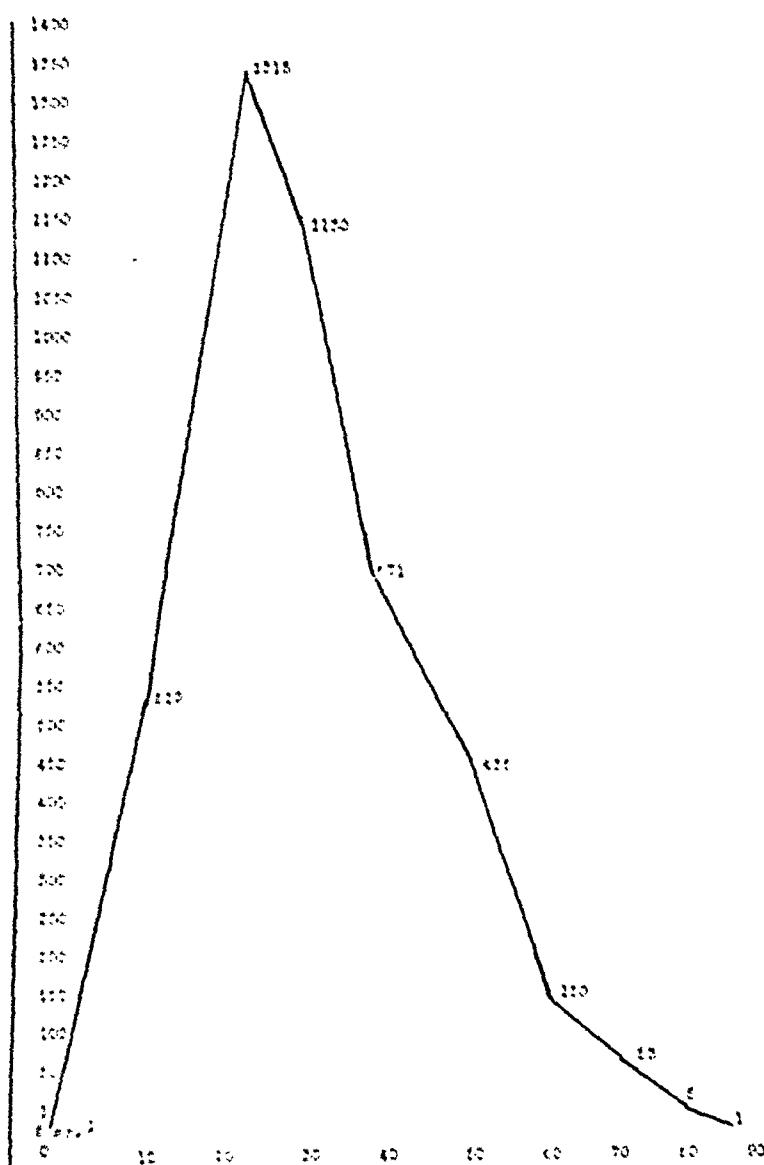


FIG. 1. Chart showing the age range in 4,283 cases of appendicitis.

ritis in children and adults varies. Appendicitis in children frequently does not follow the rules. Rigidity and tenderness are often difficult to elicit especially in very young children. In children up to five or six years of age it is usually most difficult to obtain proper data for arriving at a conclusion as to the cause of the illness. The symptoms in children are rather variable and little dependence can be placed upon the child's statements. But the greatest dependence must be placed upon the abdominal examination by the

pendix. The physical examination of the abdomen supersedes the laboratory examination. The stage of the disease, the anatomical location and the type of incision can be determined by careful evaluation of all the factors before operation.

#### AGE

The youngest patient operated upon was a baby eight months old. The oldest patient operated on was eighty-one years old. The former recovered as did the latter.

It will be noted (Fig. 1) that the greatest number of patients (2,445) were operated upon between the second and third decades. In the fourth and fifth decades there were 1,109 patients operated on.

As stated above appendicitis in children progresses rapidly and no time should be lost operating upon them. One child eighteen months old was sick three days with symptoms of appendicitis. At operation a perforated appendix with peritonitis was found. He recovered.

Appendicitis in the aged is a serious condition because the great majority are far advanced cases, usually of the gangrenous perforated type.

#### CAUSE

The cause of appendicitis is unknown. Hematogenous infection plays a part undoubtedly in many cases, and is particularly dangerous when associated with "sore throat." Obstruction to the circulation may be due to fecoliths, other foreign bodies as well as to anatomical deformities. Indiscretion in diet is often a determining factor. I have noticed, however, a strong relationship between the eating of "hot dogs" and appendicitis. John B. Deaver often stated in his clinic that an appendix once infected is always diseased. He also said "the appendix never forgets," meaning of course after the first attack others are sure to follow. However, obstruction of the appendiceal lumen from without or from within appears to be the trigger which sets off most acute attacks.

#### INCISIONS

Many types of incisions have been advocated: the straight incision, the McBurney and the so-called extraperitoneal or lateral approach for those appendices lying in the loin space. Much has been written about the use of the McBurney incision in acute appendicitis. I use it in some types of this disease, especially in those suffering from chronic appendicitis. In my opinion, it is a fallacy to state that the mortality of acute appendicitis can be

reduced by the use of the McBurney incision. The field through which one works is very limited and, therefore, in removing an appendix acutely inflamed more traumatism is inflicted. It is also claimed for the McBurney incision that when an infection occurs in the wound there is less likelihood of hernia resulting. I have observed this complication following infection even after the muscle splitting incision. With the straight incision, the site of operation can be visualized more thoroughly and the appendix, therefore, can be removed more readily. It is a well known fact that the location of the appendix anatomically may vary. It may assume twelve to fourteen different positions. The incision should always be planned with this fact in mind.

#### SULFA DRUGS

The indications for the use of sulfanilamide and other sulfa drugs have been materially broadened on account of its use in inflammatory conditions other than streptococcal infections. It seems to do more good in those cases that have perforated causing as a result a localized abscess or a spreading peritonitis. In some patients the results are magical. Even before the use of sulfanilamide the majority of these cases recovered but there is no doubt the sulfa drugs have saved many lives. Since 1937, when prontosil and its derivatives were introduced we have encountered four deaths. A child eight years old was admitted to the hospital in February, 1937, with symptoms of general peritonitis. Upon opening the abdomen a large amount of pus exuded. The appendix was removed but was not considered the cause of the peritonitis. Prontosil was used. One patient was admitted to the medical wards in February, 1940. He was transferred to surgery after several days of observation. At operation a suppurative appendicitis was found. He developed later a pelvic abscess which was drained. Following this he eventrated the contents of the abdomen. Sulfanilamide was used. A patient

sixty-four years old was admitted to the hospital, March, 1941, several days after the initial symptoms of appendicitis. When operated upon an acute perforated gangrenous appendix accompanied by general peritonitis was found. Sulfanilamide was used without avail. A child three years old was admitted to the hospital, October, 1941. At operation an acute perforated appendix was found. The patient received 8 Gm. of sulfanilamide after operation on account of a misunderstanding between the medical and surgical services.

#### COMMENT

While the sulfa products have acted magically in many cases, the impossible cannot be expected in a review of the above reported deaths. In the first case we were dealing with a primary peritonitis, a rather fatal disease in children. In the second case, consultation was not asked for at the proper time. The third case was treated too long at home. In the fourth case it is evident an overdose of sulfa was administered.

#### EMERGENCY OPERATION VERSUS DELAYED OPERATION

There is no question that the diagnosis once having been made, the appendix should be removed immediately. In children the operation should be performed at any time of the day or night because in the young the appendix has the peculiar faculty of becoming gangrenous in a comparatively short time. The absence of pain after a very severe initial manifestation portends great danger, especially in children. I have been consulting surgeon to the Foster Home for Jewish children for over twenty-five years. By making the resident nurse appendicitis conscious, abdominal pain in a child is promptly reported. We have never lost a patient following operation for this disease at this institution. In adults after the symptoms have been present for two or more days it may not be necessary to operate immediately especially if they arrive in the

wee hours of the night. It is better to give glucose parenterally and remove the appendix at an opportune time in the morning. An inflamed appendix should always be removed. Simple drainage of the abscess is an incomplete operation. A gangrenous appendix that remains is always a source of infection and the sinus commonly does not heal unless the offending organ is finally removed. There are some neglected cases encountered where the appendix has entirely sloughed off at its base. In these cases nature has amputated the appendix. Drainage of the abscess is the preferred operation in such instances. Many of these cases require a subsequent operation for the closure of a fecal fistula. A gangrenous, perforated appendix adjacent to its insertion at the cecum requires a special technic. A cecostomy should be performed and a pezzer catheter inserted, protected by the great omentum. Obviously inversion of the cecum cannot be done.

#### DRAINAGE

With a greater experience the surgeon is inclined to use less drainage after operation for acute cases. In a patient, however, where perforation has occurred and a localized collection of pus is found, drainage should be instituted. The best results are obtained in badly infected cases when the wounds are kept wide open. All drainage is removed at the end of five days. When stitches are considered necessary because of a lengthy incision, through-and-through silkworm gut or dermal sutures are passed through all the layers of the abdomen and loosely tied. No attempt is made at tier suturing. The incidence of hernia is not increased by through-and-through sutures. In fact it has always seemed to me the danger was less with this technic.

#### ANESTHESIA

As a result of the division of appendicitis into acute, subacute and chronic types, the kind of anesthetic used can also be varied depending upon the degree of inflammation

that exists. In chronic appendicitis a general anesthetic may be used. In patients in the acute stages of the disease, those in whom we suspect perforation, localized peritonitis, abscesses or an acute unruptured appendix with high leukocytosis, spinal anesthesia is the choice as compared with all other types of anesthetics. As stated in a former paper, spinal anesthesia saves lives rather than destroys them. On account of the relaxation of the abdominal wall one can localize the operating area without spreading the infection. This is probably the most important factor in the reduction of mortality in patients suffering from acute perforated appendicitis. As a result of this type of anesthetic I have used what I have been accustomed to call the two forceps technic. In this technic the colon is visualized through the incision and two Russian tissue forceps are used, one in either hand to pick up the cecum. This frequently allows the appendix to be delivered into the wound without the insertion of the finger into the abdominal cavity. In children ether is the anesthetic of choice. On account of an upper respiratory infection chloroform was administered to a child twelve years old. She died of acute yellow atrophy of the liver which was verified at postmortem examination.

Complications depend largely upon the care and the gentleness used at the time of operation. Some complications are unavoidable. Intestinal obstruction, for instance, may result from a simple adhesion between the intestine and the parietal peritoneum or from an adhesive kinking of the gut upon itself. Symptoms of intestinal obstruction may appear shortly after operation and the sooner these adhesions are released and the intestines placed in their normal position again the more quickly will the symptoms subside. I have performed five successful operations all in a comparatively short time on the same patient with persistent intestinal obstruction. These operations consisted in the release of adhesions, ileostomy or colostomy, closure of colostomy or ileos-

tomy and the repair of the incisional hernia which almost invariably occurs after drainage cases. Today these cases should all be afforded the benefit of a trial on Wangensteen suction, for the inflammatory type of obstruction is the type that responds most readily to this method. Four of our patients died of intestinal obstruction.

#### HEMORRHAGE

Hemorrhage following an appendectomy is a very rare complication. We invariably invert the stump of the appendix. One must take care not to puncture the small blood vessels in the wall of the cecum. If this is done a rapidly forming hematoma may result. Several years ago I operated on a man, twenty-one years old, in whom this complication developed. At reoperation an enormous hematoma of the mesentery was found and he died despite the use of blood transfusions.

Secondary abscesses occur in neglected cases or those that have been delayed too long for operation. Secondary collections should be opened wherever they occur. The usual sites are the left iliac fossa, the subhepatic and suprarenal spaces.

#### MORTALITY AND STATISTICS

Out of the total number of operations performed there were seventy-one deaths (1.65 per cent). Of these there was a total of 2459 acute cases of appendicitis operated upon; thirty-three cases (1.34 per cent) of acute, perforated, gangrenous appendicitis, complicated by general peritonitis died. Thirty-four (0.79 per cent) cases died, not as a result of appendicitis but following the primary condition for which they were operated upon. Four deaths (.093 per cent) resulted from acute intestinal obstruction.

#### CONCLUSIONS

1. Chronic appendicitis is a distinct entity.
2. The diagnosis of appendicitis in children is often difficult to make.

3. In my experience the McBurney incision has not decreased the mortality following operations for acute appendicitis.

4. I have never regretted using the straight incision provided it is placed properly over the site of the diseased appendix.

5. While sulfa drugs have made an unusual contribution in the outcome of patients suffering from acute gangrenous, perforated appendicitis, I have not used it a sufficient number of times to present

confirmatory evidence of its efficacy. The great majority of these cases recovered before the advent of these drugs in 1937.

6. With added experience less drainage of acute cases is used.

7. Excepting children spinal anesthesia is used in all acute cases.

8. Some of the complications are discussed.

9. Out of 2,459 acute cases, thirty-three patients died (1.34 per cent).



THE syndrome of chronic ulcerative colitis may develop as a result of infection by one or more of several bacterial and animal parasites, or in association with certain dietary and constitutional deficiencies, or as a result of poisoning with certain chemicals.

# SULFONAMIDES IN FRESH AND CONTAMINATED WOUNDS\*

## MODE OF APPLICATION

COMDR. EMILE HOLMAN, M.C. V.S U.S.N.R.

Chief of Surgery, U. S. Naval Hospital

MARE ISLAND, CALIFORNIA

EVIDENCE is accumulating that certain conceptions in surgery, hitherto considered fundamental, must be greatly modified in the light of new experiences in the treatment of contaminated and infected wounds by the local and systemic administration of the sulfa compounds. Strode<sup>1</sup> following the Pearl Harbor debacle, reports the prolongation of the "golden period" for the débridement and closure of wounds from six to seventy-two hours by the immediate application of the sulfonamides to the wounded area. At the Mare Island Naval Hospital we have been able successfully to repair divided tendons twenty-six hours after the accident, administering the drugs locally at the time of repair and orally after the operation. At the same hospital, injuries to soft parts, compound fractures, compound injuries to skull and brain, have been treated, when first seen, by the local application of the sulfonamides, followed at operation by irrigation, débridement or excision, and again by the local application of the drugs, supplemented after operation by their systemic administration. Repeatedly, such treatment has resulted in the phenomenal healing of apparently hopelessly contaminated wounds. It is increasingly apparent, however, that the mode of application of these drugs is one of the most important factors in determining their effectiveness as miracle workers. Too often their administration is deferred until the patient reaches the operating table, and here, too, the mode

of application may not be productive of the best possible results.

The following precautions and procedures appear fundamental at the present time, though subject to change as fresh knowledge concerning these potent drugs is obtained:

1. For local application, finely powdered or finely crystalline sulfathiazole and sulfanilamide are used in a mixture of equal parts (a) sulfanilamide, for its comparatively quick and easier solubility and therefore more prompt absorption (b) sulfathiazole, for its more prolonged action due to less solubility. Sulfanilamide and not sulfathiazole is used intracranially, due to the harmful inflammatory reaction initiated in brain tissue by the latter.

2. Whenever possible, this mixture should be applied immediately after the injury, at the first dressing by "first aider," nurse, or doctor. The fighting men themselves, stretcher bearers, corpsmen, nurses and doctors should be taught to introduce 15 Gm. of the mixture, (or of sulfanilamide, or of sulfathiazole if only one is available), directly into any large wound at the earliest opportunity—if possible the moment after it is sustained, or when first seen, or at the time of applying the first field dressing, or while awaiting transportation to an emergency station. A determined effort should be made to introduce it into the depths of the wound and under flaps of avulsed muscle or skin.

3. Immediately upon arrival at the emergency station or at the hospital, when

\* The opinions contained herein are the private ones of the author, and are not to be construed as official or reflecting the views of the Navy Department, or the naval service at large.

the wound is being inspected to determine its character and extent for proper disposition of the case, the drugs should again be applied in generous amounts, directly or by atomizer, to every pocket and crevice of the wound, under elevated or avulsed flaps of skin, in exposed intermuscular planes, around denuded bone and among bone fragments. The prompt application of the drugs to *all* contaminated surfaces at the earliest possible moment, even before treatment for shock is instituted, will lead to their early absorption and effective concentration in those tissue fluids most heavily exposed to bacterial contamination, thus providing for the early inhibition of bacterial growth. In the meantime, preparations for the treatment of shock, or arrangements for the removal of the patient to the operating room, are being made.

4. At the operating table, following thorough irrigation of the wound, the local application of the drugs should not be deferred to the end of the operation, but should proceed simultaneously with the débridement or excision of the traumatized tissue. As soon as freshly incised, raw areas are exposed by the excision of tissue, the powder mixture is gently rubbed over the newly produced surfaces. Mixed with blood and tissue fluids, the powder makes a milky suspension, which is easily brought into contact with all crevices of potentially contaminated tissues. Simple "frosting" of the wound, as advocated so universally, is not equally effective in bringing the powder into contact with *all* contaminated tissues.

This periodic application of the drugs in stages, as the operation proceeds, insures their presence in the tissues almost simultaneously with, or even before, the contamination of these same tissues and tissue fluids by bacteria. It also insures that no crevice or pocket of the wound is missed. In operating in the presence of grossly infected tissues as in the repair of a colostomy or of an intestinal fistula, I have made it a rule to apply the powder every

few minutes, whenever a new area of freshly incised tissue is exposed, whether it be in the abdominal wall, the mesentery, or the retroperitoneal spaces. In open resections of the bowel, or stomach, the powdered mixture is applied to all raw mesenteric areas before entering the lumen of the viscus in order that the inhibiting, antibacterial agent is present in the tissues *before* their contamination by bacteria. Similarly, in pneumonectomy and lobectomy, after mobilization of the hilum and ligation and division of the hilar vessels, the powdered suspension is brought into contact with mediastinal surfaces, the exposed pleura, and the exposed edges of the incision in the thoracic wall *before* opening the infected bronchus. In this way operative areas are impregnated with the drug one and two hours earlier than would be the case if application of the drug were deferred to the end of the operation. Moreover, the impregnation of tissue fluids with the sulfa mixture before their contamination by bacteria, which may be inevitable as the operation proceeds, is, I believe, a most important factor in the inhibition of bacterial growth.

5. It is important in the final local application of the sulfonamides to avoid large dry masses and clumps of powder in the wound. To dump large amounts of the dry powder into a wound or into the peritoneal cavity, or as one author mistakenly advises, to "fill the wound with powder" is almost certainly inviting poor healing due to the presence of this dry or caked powder acting as a foreign body. An emulsion or suspension of the powdered drug made with blood and tissue lymph, thinly smeared over all surfaces of the wound, insures their early solution and effective absorption with the least interference with healing.

6. In those instances in which contamination has already been followed by well advanced infection as in peritonitis, the drugs must be applied to all infected peritoneal surfaces and pockets and such local application should be supplemented

immediately by the intravenous injection of 5 Gm. of one of the sodium salts, preferably sodium sulfathiazole. This can be done at the operating table preceding the intravenous administration of salt solution for the replacement of fluids. Following operation, if nausea or gastric suction make oral administration impossible, the intravenous injection of 5 Gm. of sodium sulfathiazole dissolved in 100 cc. of distilled water may be repeated twice daily. Subcutaneously or intravenously, sulfanilamide may be administered as a 1 per cent solution: 1.5 Gm. dissolved in 150 cc. of physiological saline, brought to a boil, then cooled to body temperature, may be administered by hypodermoclysis every six hours.

In certain instances in which vomiting prevents oral administration, sulfanilamide may be administered per rectum as a suspension in water: 4 to 6 Gm. of sulfanilamide powder are stirred thoroughly in 100 cc. of tap water and introduced into the rectum by catheter every six or eight hours for twenty-four hours, and then twice daily. A concentration of 4.6 mg. per 100 cc. of blood was achieved after three such rectal instillations.

Following operation, as soon as nausea or vomiting permit, sulfathiazole or sulfanilamide may be administered orally: 4 or 6 Gm. at the initial dose and 1 Gm. every four hours thereafter. Rarely is it necessary to continue the oral administration for more than four or five days, and it should be definitely discontinued at the end of ten days, or before if marked cyanosis, or a skin eruption resembling scarlet fever, or a high unexplained fever supervene. It is important to avoid overconcentration of the drugs in the urine with the possible production of sulfa crystals in the renal pelvis, ureter or bladder. Sufficient fluids must be administered to insure a urinary output of at least 1,000 cc. daily, although 1,500 cc. is preferable. The deposit of crystals in the kidneys will be further prevented if the hydrogen ion concentration of the urine is maintained between 7.2 and 7.4 by the simultaneous administration

of 1 Gm. of sodium bicarbonate with each gram of the drug.

The following case report illustrates the use of the drugs in the management of a truly *generalized* peritonitis following the rupture of a duodenal ulcer at least twenty-seven hours and possibly thirty-six hours previously. Under ordinary circumstances such a generalized peritonitis with bilateral subphrenic collections of pus would have in all probability ended fatally:

#### CASE REPORT

The patient, forty-six years old, re-enlisted in the Navy on Monday, May 11, and that evening he embarked upon a prolonged celebration. Events in the next eighteen hours are remembered only hazily, but he recalls being awakened Tuesday morning with severe intermittent pains over the entire abdomen. However, he slept most of the day and when he finally awoke at 4:00, he was conscious of severe abdominal pain. He was admitted to Mare Island Naval Hospital at 11:00 P.M. Tuesday evening. There had been no vomiting or diarrhea and there had been no previous symptoms of ulcer. There was a history of syphilis in 1925, probably inadequately treated.

Physical examination disclosed a rigid abdomen, most pronounced in the epigastrium. The pulse rate was 102, temperature 101°F. blood pressure 140/90, hemoglobin 90 per cent, red blood cells numbered 4,720,000, white blood cells 21,000, 86 per cent being polymorphonuclears of which 65 per cent were mature and 21 per cent banded, blood alcohol 0.5 mg. per cent.

The admitting officer's tentative diagnosis was either a perforated ulcer or tabetic crisis. Re-examination at 6:00 A.M. Wednesday, revealed the presence of occasional abdominal cramps and severe, generalized, abdominal tenderness and rigidity with some distention. The pulse rate was 112, temperature 99.7°F. and the white cell count now numbered 27,400, 81 per cent being polymorphonuclears, of which 47 per cent were mature, 34 per cent banded. Roentgenograms disclosed a layer of air under each diaphragm, fully 2.5 cm. wide.

Laparotomy for a ruptured viscus was performed under gas anesthesia at 11:00 A.M. Wednesday, twenty-seven hours after the known onset of abdominal pain. The appear-

ance of the intra-abdominal viscera at operation suggested that perforation probably had occurred even hours earlier, but was not noted by the patient because of his state of inebriation. The operation was conducted through a short, high, right rectus incision. On opening the peritoneum there was an explosive discharge of gas. The peritoneal surfaces everywhere were injected and covered with fibrin. From under each diaphragm about 250 cc. of brownish turbid fluid were evacuated. On elevating the right lobe of the liver, a leaking perforation of the duodenum was found, 4 mm. in diameter, surrounded by inflamed indurated tissue and bathed in thick purulent exudate. The duodenum and surrounding tissues were rigid with induration over an area fully 10 cm. in diameter. On exploring the pelvis, a large amount of purulent material was found with heavy deposits of fibrin on the wall of the intestines lying there. To facilitate withdrawing this fluid a short muscle-splitting incision was made in the right flank, through which pus was evacuated by suction from the pelvis, both flanks, and between loops of small bowel. The perforation was closed with a flap of omentum anchored in place with mattress sutures of silk, no attempt being made to approximate the edges of the perforation itself. A mixture of 10 Gm. of sulfathiazole and 15 Gm. of sulfanilamide was applied to the inflamed peritoneum. Successive portions of this powder, placed in the palm of the operator's gloved hand were mixed with peritoneal fluid and applied successively to the peritoneal surfaces in the pelvis, both flanks, under both surfaces of the diaphragm and over the surfaces of the liver, the stomach, the spleen and the intestines. Both incisions were closed without drainage.

During the operation, the patient received 250 cc. of blood plasma, 800 cc. of normal saline solution and 4 Gm. of sodium sulfapyradine intravenously. At the end of the operation the pulse rate was 130, respirations 32, blood pressure 104/80. Following the cessation of the anesthetic, he immediately became very cyanotic with a pulse rate of 152 and respirations of 56. He was placed in an oxygen tent in which he remained for two days. Continuous suction through a Levine tube kept the stomach empty. He was permitted to drink two to three ounces of water at frequent intervals, provided it drained promptly through

the Levine tube. During the first twenty-four hours, postoperatively, he drank 2,500 cc. of water, but during the same period 2,600 cc. of fluid was withdrawn from the stomach by Wangensteen suction. This concession of permitting a patient to drink water or even tea, following the suturing of a perforation, or resection of the stomach, does no harm in the presence of a well functioning suction apparatus, and it relieves the intolerable discomfort of a dry mouth. Moreover, it keeps the throat and esophagus well washed, an important precaution against ulceration of the pharynx by the indwelling tube. A negative balance, that is, less fluid withdrawn than taken in, was noted on the third day postoperatively, and the tube was withdrawn on the fourth day. Rectal instillations of 300 cc. of normal salt solution every four hours, and the twice daily intravenous administration of 1,000 cc. of 5 per cent glucose solution in normal salt solution provided an adequate fluid intake.

The accompanying chart records the amount of sulfonamides administered daily and their concentration in the blood. (Table I.)

TABLE I

Date and Hour	Sulfonamides Administered, Gm.	Blood Level of Sulfa Drugs, Mg. Per Cent
5-13-42: 1100	25 I.P. 5 I.V.	
	1500	29.5
	1700	25
5-14-42: 1200	5 I.V.	15
	1600	20
5-15-42: 0900	5 I.V.	6.2
	1630	10
	2000	18
5-16-42: 0800	5 I.V.	4.5
	1600	3.9
5-17-42: 0800	2 (M) 5 I.V.	1
	1430	
	1800	2 (M)
	2 (M)	8.3
5-18-42: 0830	2 (M), t.i.d.	6.5
5-19-42: 0900	2 (M), t.i.d.	1
5-20-42: 0800	1 (M), q.4.h.	3
5-21-42: 0830	1 (M), q.4.h.	3.5
5-22-42: 0700		2.8
Soft diet		

On the sixth postoperative day the wound partially broke open with the discharge of considerable pus. The wound healed by granu-

lation and at the present time he has a definite though moderate hernia.

The culture of the intra-abdominal pus yielded *Staphylococcus aureus* and a non-hemolytic streptococcus.

In the convalescent period, his only remaining nine badly infected teeth were extracted. He has had absolutely no symptoms referable to the duodenal ulceration, and he ate a soft diet compatible with the edentulous condition of his mouth. Roentgenographic studies two months after operation disclosed no gastric retention, but a persistent deformity and irregularity of the duodenum. The patient considered himself well except for the small ventral hernia, easily controlled with an abdominal binder.

#### SUMMARY

1. In the management of contaminated wounds and potentially contaminated wounds a mixture of equal parts of sulfanilamide and sulfathiazole powder or crystals is applied in generous amounts to every pocket and crevice of the wound at the earliest possible moment whether on the field of battle, at first aid stations, or in the emergency rooms of our hospitals. At the first dressing or at the first inspection of the wound, every effort should be made to get the drug in contact with *all* raw surfaces. The earlier the drug can be applied after bacterial contamination, the more effective will be the inhibition of bacterial growth.

2. The local application of the drug should be repeated again at operation when a débridement or excision is performed. When operating in a dirty or potentially contaminated wound as during a débridement, or in the closure of a colostomy, the drug mixture should be applied at successive stages as the operation proceeds and as freshly incised areas are exposed in the operative field, endeavoring to impregnate these raw areas simultaneously with or even before their contamination by bacterial organisms.

3. In open resections of any part of the intestinal canal, or in lobectomy or pneumonectomy, the raw surfaces of incised

tissues should be impregnated with the drugs *before* opening the unsterile or infected viscus or bronchus.

4. In localized or general peritonitis, the drug should be brought into contact with all contaminated surfaces. Mixed with blood and tissue fluids, the drug is thinly smeared or rubbed over all infected peritoneal surfaces, thus insuring maximum absorption and least interference with healing. Dumping large masses of the dry powder into a wound is inviting poor healing, as it may then act as a foreign body.

5. "Frosting" a wound reaches only the superficial surfaces of a wound. A suspension of the powder in tissue fluids permits more effective contact with all nooks and crannies, all crevices of a wound.

6. After operation, when vomiting or gastric suction prevent their oral administration, the drugs may be administered subcutaneously, intravenously, or rectally:

As a 0.8 per cent solution (8 Gm. in 1,000 cc. Ringer's or normal saline solution) sulfanilamide may be administered by hypodermoclysis.

Five Gm. of sodium sulfathiazole dissolved in 100 cc. of distilled water may be given intravenously twice daily. Sulfanilamide may be given intravenously every six hours as a 1 per cent solution (1.5 Gm. in 150 cc. normal saline solution).

Four to 6 Gm. of sulfanilamide powder suspended in 100 cc. of tap water may be administered per rectum as a retention enema every six to eight hours for twenty-four hours, and then twice daily.

7. Orally, 4 to 6 Gm. of the sulfonamides may be given as the initial dose, and 1 Gm. every four hours thereafter. Rarely should it be continued in this dosage more than five days, and very rarely after ten days. Marked cyanosis, a scarletiniform rash, or a high unexplained fever demand the discontinuance of the drug. A daily urinary output of at least 1,000 cc. is imperative and 1,500 cc. is preferable.

8. Many cases including compound injuries of the extremities, skull, thorax and

abdomen, have been treated successfully according to the above principles. The complete recovery of a case of generalized peritonitis with large collections of pus in the pelvis, in both flanks, and under both leaves of the diaphragm, following the rupture of a duodenal ulcer twenty-seven hours previous to operation, is presented in detail. In this instance, the concentration of the sulfonamides in the blood reached 29 mg. per cent in the course of the first twenty-four hours after operation.

## REFERENCES

1. STRODE, J. E. Observations on the treatment of war wounds. *Hawaii M. J.*, 1: 158, 1942.
2. MOREHEAD, J. J. Surgical experience at pearl harbor. *J. A. M. A.*, 118: 712, 1942.
3. LAUFMAN, H. and WILSON, C. E. Prophylactic intraperitoneal introduction of crystalline sulfanilamide. *Arch. Surg.*, 44: 55, 1942.

4. Surgeon General, U. S. Army, Circular Letter #17. Chemotherapy in infectious diseases and other infections. *War Medicine*, 2: 466, 1942.
5. KEY, J. A. The use of sulfanilamide and sulfathiazole in orthopedic surgery. *J. A. M. A.*, 117: 409, 1941.
6. RAVDIN, I. S. et al. The use of sulfanilamide in the treatment of peritonitis associated with peritonitis. *Arch. Surg.*, 44: 53, 1942.
7. KEY, J. A. and HARBISON, S. P. Local implantation of sulfanilamide and its derivatives in wounds. *Arch. Surg.*, 44: 22, 1942.
8. LYONS, C. and BURBANK, C. Local sulfonamide therapy. *Surg., Gynec. & Obst.*, 74: 571, June 1942.
9. BISGARD, J. D. and BAKER, C. P. Treatment of fresh traumatic and contaminated surgical wounds. *Surg., Gynec. & Obst.*, 74: 20, 1942.
10. OSGOOD, E. E. Principles which should govern the local use of the sulfonamide drugs. *Surg., Gynec. & Obst.*, 75: 21, 1942.
11. JENSEN, N. K. and NELSON, M. C. Local sulfanilamide in compound fractures. *Surg., Gynec. & Obst.*, 75: 34, 1942.



# TREATMENT OF SKELETAL PAIN WITH PROCAINE INJECTIONS

AN ANALYSIS OF 295 CASES IN GENERAL PRACTICE

RALPH L. GORRELL, M.D.\*

Surgeon, Gorrell Hospital

CLARION, IOWA

**I**N the course of an average general practice, 295 patients were injected with procaine, nupercaine or eucupin solution. The magnitude of the problem of pain can be realized when one finds that 214 additional patients complaining of pain during the same five-year period were not injected, i.e., the former group had pain severe enough so that an injection, often feared and usually detested by the layman, was not objected to.

*Causes of Pain.* Table 1 lists the causes of pain as determined by myself and vari-

One must remember that a patient with proved hypertrophic arthritis of the spine does not have pain because of the bony changes themselves, inasmuch as similar roentgen views can be found in patients who have no pain. The same statement holds for patients with bony spurs of the heel.

Because of lack of definite diagnostic criteria for such diagnoses, the terms lumbago, fibrositis, myalgia, lumbosacral strain and the various neuralgias have not been used.

## PAIN IS NOT DIAGNOSTIC

The more one injects patients complaining of pain, the more one realizes that certain types of pain are not diagnostic and far from being pathognomonic. Precordial pain radiated to the left shoulder and down the left arm is an especially common cause of worry to the patient because of its possible association with angina pectoris. Chest pain, of "pleuritic" type, i.e., increased by deep respiration or cough, is quite often of superficial origin, as indicated by the lack of findings on physical and roentgenologic examination.

Pain in the low back is a common complaint. After elimination of pelvic, bladder, rectal, kidney and vertebral causes, there remains a large number of individuals who complain of low back pain in acute attacks following slight or heavy exertion or in a chronic form. The great majority of these individuals can be relieved by local anesthetic injections, exercises, heat and reduction in weight. Belts were not recommended for any patient with back

TABLE I	
I. Trauma	
A. Direct injury and bruising.....	13
B. Indirect twisting and straining	
1. Sprained ankle.....	24
2. Sprained back.....	6
3. Sprained knee.....	2
II. Protruded intervertebral disc	
A. Suspected in 9, removed in.....	3
III. "Stiff neck".....	17
IV. Painful scar.....	6
V. Osteo-arthritis.....	31
VI. Rheumatic (myalgia, fibrositis, neuralgia).....	164
A. Predominantly menopausal.....	9
VII. Miscellaneous: Recurrent painful ankle.....	2
Herpes zoster, persistent.....	1
Pleurisy, radiologically proved.....	4
Lung abscess.....	2
One each of gout, renal colic, gallbladder colic, carcinoma of stomach.....	4

Each figure represents one patient, classified under the predominant cause of pain.

ous consultants, and proved by (1) operation in a few cases, (2) roentgenologic study, (3) physical examination and (4) passage of time, which indicated that a serious underlying condition was not present. Consultation with orthopedists, neurosurgeons, internists and general surgeons at the Mayo Clinic and elsewhere was obtained.

\* Now Past Assistant Surgeon, U. S. Marine Hospital, Buffalo, N. Y.

pain, except for such times (riding a tractor or a railroad engine) when persistent jarring and strain could be expected. A belt or corset is no more a treatment for back pain than a crutch is a treatment for a painful ankle.

The relief of pain by procaine injections is not diagnostic. The pain of a protruded intervertebral disc can be relieved for weeks. A woman with a giant cell tumor of the knee and painful disability on walking was relieved by such injections. A surgically proved case of spasm of the sphincter of Vater was relieved more quickly by infiltration of the tender point over the right upper quadrant than by nitroglycerine and morphine. Abdominal pain due to a cystoscopically proved enlargement of the verumontanum and urinary retention was relieved promptly by injection. *The relief of pain by local anesthetic injections does not free one from the responsibility of determining a possible serious cause for the pain.*

Repeated recurrences of pain indicate that (1) the underlying condition has not been found, (2) auxiliary treatment has not been carried out, e.g., exercises for painful backs or (3) the "trigger points" were not injected.

#### PHYSIOLOGIC BACKGROUND

Sir Thomas Lewis' clinical and experimental work on pain<sup>1,2</sup> and Leriche's<sup>3</sup> surgical attacks on pain-carrying nerves and the sympathetic nervous system, have founded new ideas.

Pain can be studied scientifically, because it now can be produced under standardized conditions. Lewis found that pain results from the injection of hypertonic saline solution into various structures. By injection of skin and muscle, he was able to produce different types of pain.

*Skin Pain.* The pricking of a needle into the skin results in a sharp, localized "sticking" pain; the same type of pain appears if saline solution is injected rapidly or when the skin is touched with a hot wire.

"Burning" pain results when a prolonged stimulus (freezing or heat) is applied to the skin.

Abrasions, fine multiple scratches, freezing, ultraviolet irradiation and continued friction result in the same type of pain. The subject cannot distinguish between them but complains merely of "burning." (What does the patient mean when he complains of a burning pain?)

"Dull" pain arises from deeper structures. If hypertonic saline solution is injected into muscle, a dull, poorly localized, "aching" or "sickening" pain results, resembling that found in rheumatic and arthritic conditions, and muscle and ligament pains. Even procaine solution, if injected rapidly into muscle or fascia, will procure this dull, "full" type of distress.

*Nerve Pain.* A sharp, shooting pain indicates that a nerve has been involved, or that a sensitive structure such as a sheet of fascia has been touched with the needle.

#### TECHNIC OF INJECTION

The "trigger point" must first be found. This point can be found by palpating, in the painful area itself, around it or between it and the spinal column, for an area which is markedly tender. If the patient does not wince when pressure is made on a point, it is probably not the one sought. If finger tip pressure causes the patient to say, "That is my pain," one may confidently predict relief.

If several areas of tenderness are found, mark each with a skin marking pencil or a drop of colored antiseptic solution, then compare to determine which are the most tender and inject only those causing wincing tenderness.

Multiple areas can be treated only by multiple injections, with definitely poorer results than injection of one or two points, by infiltration of the entire area with  $\frac{1}{2}$  per cent procaine solution or by infrared radiation or short wave therapy.

*Depth of Injection.* A wheal is raised with a fine needle by injecting four or five drops directly into the skin. A No. 24 gauge

two or three inch needle is then attached, and gently inserted through the wheal and into the deeper structures until underlying bone is reached or the patient complains of pain. Two cc. of procaine is injected when pain is elicited. After a wait of one-half minute, palpation is then carried out to see if tenderness has disappeared. If no pain is produced by pressure, that "trigger" point has been treated sufficiently. If some tenderness persists, the needle is introduced farther and the process repeated. It is of clinical research interest to note at what level, and approximately in what structure, the painful area is located.

*Types of Solution.* Procaine solution of 1 per cent strength was used in the great majority of these injections. Nupercaine solution (1:1000) is a longer acting local anesthetic which gives better results in chronic painful conditions.

*Patient's Position.* Except for the most trifling injection, the patient should be kept lying down, and preferably so placed that he cannot see the needle or the injection. He should be told of the initial prick of the needle but should not be asked repeatedly if pain is present.

Nervous or apprehensive patients had best be given a small dose of barbiturate, e.g., 1½ gr. of nembutal, preceding the injection. One patient out of three will feel dizzy or faint if allowed to sit up promptly after the injection of 10 cc. or more of procaine or nupercaine solution, so that it is best to have all patients remain lying down for ten minutes thereafter.

*Has Enough Solution Been Injected?* The patient should assume the position or go through the motions which caused him pain previously, before one should assume that all trigger points are treated.

*How Many Injections Are Needed?* One injection relieves 25 per cent of muscle and ligament pains; two injections bring relief to half of the patients. The injections are given at two or three day intervals. If longer and longer periods of relief are not obtained by each injection, in the

remaining group, the patient should be restudied for other causes of pain or questioned about work which may be aggravating the condition.

*What Should the Patient Be Told?* The patient should be informed that in most cases there is a reaction from two to six hours after the injection. At this time, the pain may recur and may temporarily be worse than previously (he should have analgesic tablets to take during this time). Following this episode, either the pain will disappear leaving only a residual stiffness or it will persist. He should be told to carry out his usual daily routine, with avoidance of heavy, straining positions or movements.

#### ANATOMIC BACKGROUND

Through the courtesy of Dr. T. T. Job, Professor of Anatomy at Loyola University School of Medicine, several weeks were spent in dissecting various painful areas and attempting to determine the source of pain and the structures which the injecting needle touched or penetrated. This material will be reported separately. Dr. Job's caution should be remembered: "Don't speak of muscle pain. All muscle fibers are encapsulated in fascia. There are no nerve endings in muscle except motor end plates; pain nerves are in the fascia."

#### SUMMARY

Procaine injections will cure the great majority of muscle, fascia and ligament pains. Relief is only temporary, though often gratifying, if an organic cause is still at work or if improper work or posture is persisted in. Such injections are of little value if trigger points are not found and each injected.

In the long term view, such injections must be considered as only a part of the treatment of osteo-arthritis and rheumatic conditions. The correction of posture, removal of foci of infection (occasionally), reduction of weight, avoidance of chilling and overwork, the daily use of "limbering up" exercises, all must be considered.

# VENOGRAPHY AS AN ESSENTIAL AID IN THE TREATMENT OF VARICOSE VEINS\*

SAMUEL H. SEDWITZ, M.D.

Chief of Peripheral Vascular Clinic,  
Youngstown Hospital Association

AND

EDGAR C. BAKER, M.D.

Attending Roentgenologist,  
Youngstown Hospital Association

YOUNGSTOWN, OHIO

FOLLOWING the work on venography reported by Bauer,<sup>1,2,3</sup> Starr, Frank and Fine,<sup>4</sup> Fine and Sears,<sup>5</sup> Homans and Dougherty,<sup>6</sup> we adopted the procedure to study chronic conditions of the lower extremities resulting from disorders of the venous circulation. This was prompted by the occurrence of postoperative complications.<sup>7</sup> Treatment of these complications was costly and caused much loss of time.

Since the adoption of this procedure as an essential routine in working up cases, there has been no occasion of post-operative complication in our last series of 148 cases. We found the percentage of cases rejected for treatment after venographic study was the same as the percentage of postoperative complications reported in a previous publication.<sup>8</sup>

Information gained by our study afforded us increased knowledge of the anatomy and physiology of the venous circulation.<sup>9</sup> One fact observed by fluoroscopic examination during injection of the diodrast with the patient in the supine position, was the rapidity of the dye seeking the deeper avenues of return as early as was possible, regardless of which distal small superficial vein on the dorsum of the foot was selected as the site for injection. This fact obviates the use of the tourniquet technic as described by Mahorner.<sup>10</sup> We believe by the use of the tourniquet any superficial phlebitis of the lowermost part of the leg and foot is not revealed. We do believe with him that it is of advantage in trying to ascertain distal deep phlebitis in cases postoperatively and in those in which there exists an old ulcer with a thrombophlebitic history.

Another fact learned was that one could not place utmost reliance on the value of the generally accepted tests used to determine the status of the deep venous circulation. This applies to the tests we routinely employ, namely, Trendelenburg, Perthes, Oscher-Mahorner, Pratt and Heyerdale, recently reported.<sup>11</sup> In three instances complications occurred when Veal's venous pressure studies were made.

The fallacy encountered in these tests is the inability to establish the existence of a very small segment of the deep venous system involved by an old thrombotic process which lights up after massive injection. Likewise we have seen many instances of retrograde flow occur in veins with good functioning valves and no evident disorder to explain the change of flow. This finding has never been proved to produce ill effects after injection.

## X-RAY TECHNIC

The dye used in diodrast 35 per cent. The Dolan mouth test prior to injection is given the patient. Twenty cc. of the dye is given slowly through a small needle (No. 26 to 27 gauge) over a period of approximately two minutes into a small vein on the distal portion of the dorsum of the foot below the external or internal malleolus.

In our own experience, it has only occasionally been necessary to cut down on a vein to inject the dye. Such cases have had marked edema or swelling of foot and ankle, and it was not possible to find a vein without incision. All patients are placed in the supine position. Changing

\* From the Peripheral Vascular Clinic and Department of Radiology, Youngstown Hospital Association.

angles of the table, Trendelenburg and opposite, have proved to be disadvantageous in visualizing upper thigh and iliac veins.

Two lead screens placed on either side of the top of the Bucky table have been used recently. These are of sufficient width and are so placed that the intervening space allows the coverage of half a 14 by 17 film. These lead screens are long enough to reach from the ankle to the lower abdomen. The leg can be satisfactorily positioned between these screens so that the entire venous circulation of the leg, thigh and lower pelvis that we wish to visualize can be portrayed on serial films.

During the time of the two minutes' injection, six exposures are made. Two exposures of the leg are made from approximately the ankle upward after about 4 to 5 cc. of the dye has been injected. As soon as the tube stand and Bucky tray can be shifted upward, two more exposures are made of the upper leg, knee, and lower thigh. Again, the tube stand and Bucky table are shifted upward and two more exposures are made which include the upper thigh and lower pelvis. These exposures are in pairs and each exposure is made from a stereoscopic position.

We realize that stereoscopic examination of any part requires that that part be absolutely still for a proper stereoscopic view. However, the dye remains long enough in one place to allow us to differentiate between the deep and superficial circulation. This has proved to be very important and is very difficult to demonstrate by single film examination. By rapid work, it is possible to complete six of these exposures in the time that the dye is injected. Occasionally, a fourth film is made with two exposures, one on either half of the film, after the conclusion of the injection. Usually, this film is made of the upper leg and knee area.

By such procedure, we obtain a series of overlapping films of the region from the ankle up to and including the lower pelvis. The time interval between these films

is such that in the normal case, visualization of the venous structure of leg and thigh into which the dye enters is obtained. The fourth film gives us added information about the upward passage of the dye in the upper portion of the leg. The stereoscopic film enables us with considerable certainty to reconstruct anatomical positions.

#### SUMMARY

We believe the use of serial venography affords valuable information in the study of the deep venous circulation of the lower extremities. Since this procedure is simple, free from contraindication to its use in the face of any disorder, and because of the great benefit we have derived in avoiding postoperative complications, we do not hesitate to state that no preoperative study of the deep venous circulation is complete without the use of venography.

#### REFERENCES

1. BAUER, GUNNAR. A Venographic Study of the thrombo-embolic problems. Monographic. Mariastadt Hospital, Mariastadt, Sweden.
2. BAUER, GUNNAR. *Arch. Surg.*, 43: 462-472, 1941.
3. BAUER, GUNNAR. Early diagnosis of venous thrombosis by means of venography and abortive treatment with heparin. *Acta. med. Scandinav.*, 107: 136-147, 1941.
4. STARR, A., FRANK, H. A. and FINE, J. Venographic diagnosis of acute thrombophlebitis of lower extremity. *J. A. M. A.*, 118: 1192-1195, 42.
5. FINE, J. and SEARS, J. B. The prophylaxis of pulmonary embolism by division of femoral vein. *Ann. Surg.*, 114: 801-812, 1941.
6. DOUGHERTY, J. and HOMANS, J. Early diagnosis of venous thrombosis by means of venography. *Surg., Gynec. & Obst.*, 71: 697-702, 1940.
7. SEDWITZ, S. H. and STEINBERG, M. H. Sclerosing of varicose veins by ligation and one massive injection of sodium ricinoleate (sorcin). *Am. Heart J.*, 15: 671-680, 1938.
8. SEDWITZ, S. H. Use of heparin for complications which follow sclerosing of varicose veins by massive injection. *Am. Heart J.*, 24: 774-776, 1942.
9. BAKER, E. C. and SEDWITZ, S. H. Observations on venography of the lower extremities. *Radiology*, Nov. 1943.
10. MAHORNER, HOWARD. A method for obtaining venograms of the veins of the extremities. *Surg., Gynec. & Obst.*, 76: 41, 1943.
11. HEYERDALE, W. W. *Proc. Staff Meet., Mayo Clin.*, 17: 221, 1942.

# Case Reports

## ABDOMINAL PREGNANCY—FIFTH MONTH\*

LOUIS E. PHANEUF, M.D.

AND H. EDWARD MACMAHON, M.D.

Member of the American Board of Obstetrics  
and Gynecology

Diplomate of the American Board of Pathology

BOSTON, MASSACHUSETTS

BEFORE the days of careful histological study of specimens removed at operation, it was believed that the ovum could be implanted upon any portion of the peritoneum with a resultant primary abdominal pregnancy. With careful study of the material, it is now conceded that most abdominal pregnancies are the result of a ruptured tubal pregnancy and are, therefore, secondary rather than primary abdominal pregnancies. The hemorrhagic complications of this condition may be extremely severe as exemplified by the case reported.

### CASE REPORT

Mrs. M. R., a thirty-eight year old married, white woman, was brought to the Malden Hospital as an emergency patient, following a vaginal examination in a physician's office on April 17, 1942. She was in shock and complained of severe right lower quadrant pain associated with nausea and vomiting. She had been perfectly well up to three months prior to admission to the hospital, when she noticed a constant dull aching sensation in the right lower quadrant. The pain was not relieved by rest, it was not increased by exercise, nor did it radiate in any direction. Two months before admission she had an attack of sharp severe pain which started in her right back and which radiated forward to the right lower quadrant of the abdomen. This lasted ten minutes and disappeared after rest in bed. At approximately the same time she noticed a constant vaginal discharge, which had not been observed previously. Over a

period of four weeks, the attacks increased in number, severity and duration, and during one very severe attack, there was swelling of the abdomen, this lasting from twelve to fourteen hours. Six weeks before admission, there was observed a small lump in the right lower quadrant which gradually increased in size. She consulted her physician and was told that she was either pregnant or that she had a tumor. He treated her by means of injections which did not relieve her symptoms. One month before admission she had a sudden vaginal hemorrhage, passed approximately a cupful of blood, and was subsequently aware of a daily, dark brown stain on her underclothing. For the last month the pain in the right lower quadrant constantly increased in severity and became so frequent that it was necessary for her to spend most of her time in a reclining position in bed or on a couch. Between the attacks of severe pain she always experienced a dull ache. During these four weeks she noticed that her lower abdomen had increased approximately twice its normal size, and the mass was directed downward and toward the median line. On the day of admission to the hospital she consulted another physician who told her that she was seven months' pregnant. While seated in the doctor's office she felt suddenly faint and collapsed. Upon recovery from her syncope she was seized with terrific right lower quadrant pain, which radiated to the back, this pain being more severe than any she had previously experienced. She also felt nauseated and vomited two or three times, she had a marked sense of weakness and prostration, with difficulty in breathing, and she had a sense of impending death.

\* From the Departments of Gynecology and Pathology, Tufts College Medical School, and the Obstetrical and Gynecological Service of the Malden Hospital, Malden, Massachusetts.

Her periods had always been quite regular, lasting seven to ten days, and were accompanied with marked dysmenorrhea in the form of right lower quadrant pain.

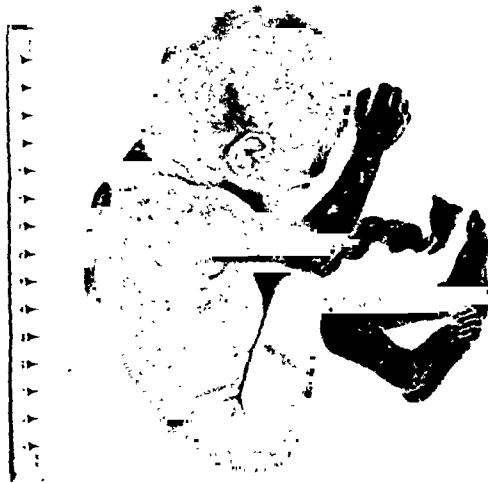


FIG. 1. Fetus, well developed and well nourished, weighing 530 Gm. Several cm. of cord are still attached.

The patient, whose husband is living and well, had had two previous pregnancies; the first child was seventeen, and the second fifteen

She had had the usual diseases of childhood, and rheumatic fever at the age of fifteen years; this necessitated her remaining in bed three months, and she was told that she had a heart involvement. Subsequently she was examined by five physicians who informed her that her heart showed no abnormalities, and there had been no further cardiac symptoms. There had been infrequent attacks of tonsillitis. Fifteen months before admission to the hospital she had an attack of polyarthritis, accompanied by swelling, pain and redness, and involving both elbows and both knees. Bed rest for approximately two and one-half months arrested the condition, and there had been no further attacks. There had been no other hospital admissions or operations.

The patient was seen as a thirty-eight year old woman lying in bed in apparent great pain; she was pale and dyspneic; there were beads of perspiration on her forehead; her extremities were cold and clammy and she was apparently in profound shock. The head was grossly normal; the chest was symmetrical; the lungs were resonant and clear throughout; the heart showed the typical signs of mitral stenosis; the pulse was so rapid it could not be counted, and the blood pressure was unobtainable. The

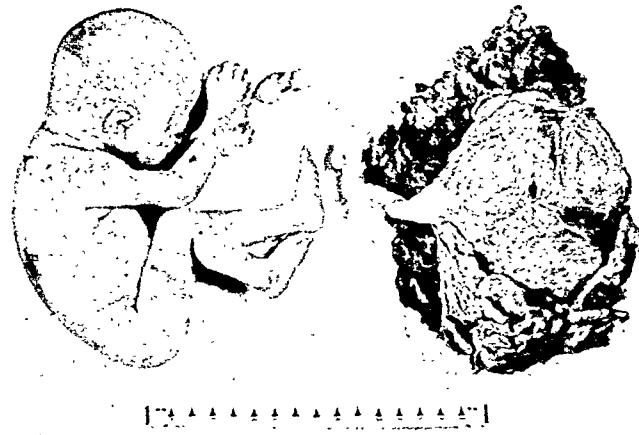


FIG. 2. Fetus with attached cord and placenta. The cord is of average diameter, but somewhat shorter than normal. The marginal attachment of the cord is clearly shown. Along this margin, the chorionic villi form a thick fringe and project freely beyond the chorion and amnion.

years of age. Her mother had died from a disease unknown to her, and her father from influenza. One sister had died in childbirth, and four brothers and three sisters were living and well. There had been no familial diseases.

abdomen showed a large mass which rose above the umbilicus, occupying the right lower quadrant and part of the left; it was extremely tender to palpation and there was definite spasm of the muscles over that area. There



FIG. 3. Placenta, weighing 275 Gm. This picture shows the maternal surface with a short segment of cord emerging from one side. Along one margin, the chorionic villi project in coarse masses. The villi are delicate and show no tendency toward cyst formation. The remaining maternal surface is comparatively smooth, but coarse and leathery.



FIG. 4. This resembles Figure 3, but in addition, shows the relative position of the buried tube within the substance of the placental mass. This is indicated by a sound which has been passed through the tube to emerge at both the proximal and the distal ends of the tube. The tube was deeply hidden and was only uncovered after making linear parallel incisions into the thicker portion of the placenta.

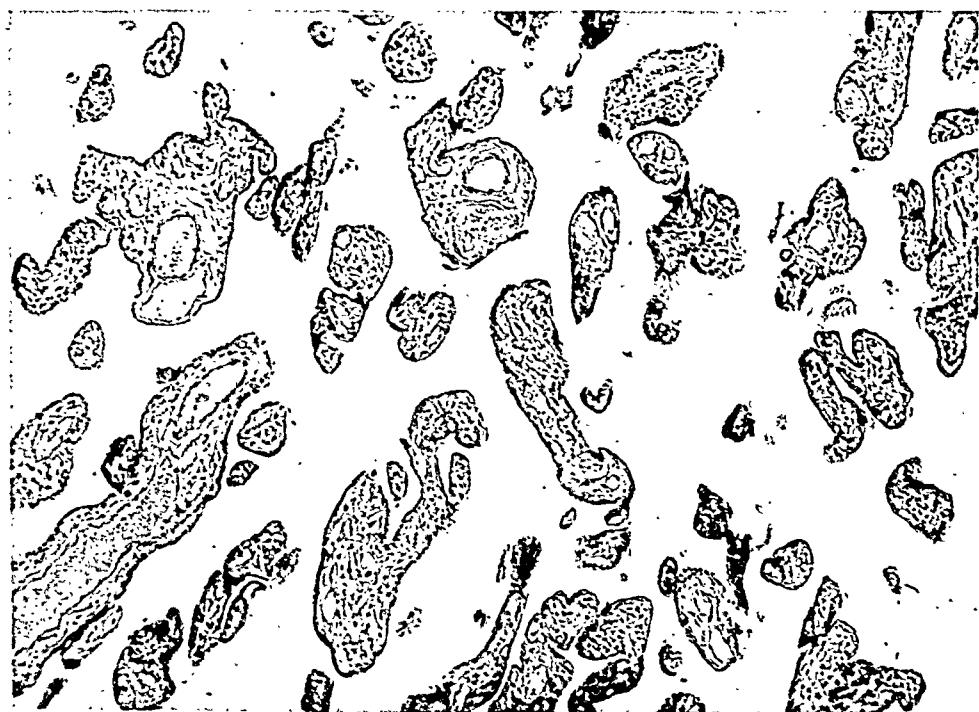


FIG. 5. Many healthy chorionic villi seen in longitudinal and cross-section. Such tissue is representative of the mass of villi projecting from the chorion adjacent to the attachment of the cord. Each villus is well vascularized and in many, the vessels are over-distended. The stroma is loose but not edematous. The inner layer of trophoblastic cells—Langhans cells, has disappeared, and the outer syncytial cells are flat and inconspicuous. The intervillous spaces are patent and free of fibrin.  $\times 108$ .

was no tenderness in the upper part of the abdomen and peristalsis was not observed at the time of examination. A vaginal examination

of citrated blood intravenously. With this treatment she gradually came out of her shock and she continued to improve, although her



FIG. 6. Section through an area of the placental mass adjacent to the tube. This picture clearly shows ovarian tissue in the upper two-thirds of the block, and fibrin, disintegrating red blood cells, and the shadowy outlines of necrotic villi in the lower third. There is very little attempt at organization of this mass of blood and fibrin. A dense band of fibrous tissue separates the placental tissue from the ovary. Above this, the stroma of the ovary is edematous. A medium-sized vein, moderately dilated, lies just above the center of the field, and just above and immediately adjacent to the latter, lies a hyalinized corpus luteum. There is no decidua reaction within or along the surface of the ovary.  $\times 24$ .

was not done because of a steady trickle of blood through the vagina. Her red blood count was 3,000,000, and her hemoglobin, (Sahli) 40 per cent.

After her admission to the hospital she was seen by several members of the visiting staff who agreed that she had had a lower abdominal accident with hemorrhage, and that the abdomen should be explored after her shock had been combatted.

She was placed in the Trendelenburg position; heaters and blankets were applied and morphine sulfate, gr.  $\frac{1}{6}$  (10 mg.) was administered. She was given 500 cc. of blood plasma, 1000 cc. of normal saline solution and 500 cc.

pulse remained rapid and thready. Fifteen hours after the admission the blood pressure was 120 systolic and 70 diastolic and the pulse, although elevated in rate, was strong in character. During her stay in the hospital the abdomen became progressively larger and duller, there was greater tenderness and the spasticity involved the entire abdominal wall. At this time one of us, (L. E. P.), was called in consultation. The patient was then pale but not in shock; the pulse was weak in character and 140 in rate; and the abdomen was distended and boardlike, making it impossible to feel any individual structures through the abdominal wall. A vaginal examination re-



FIG. 7.

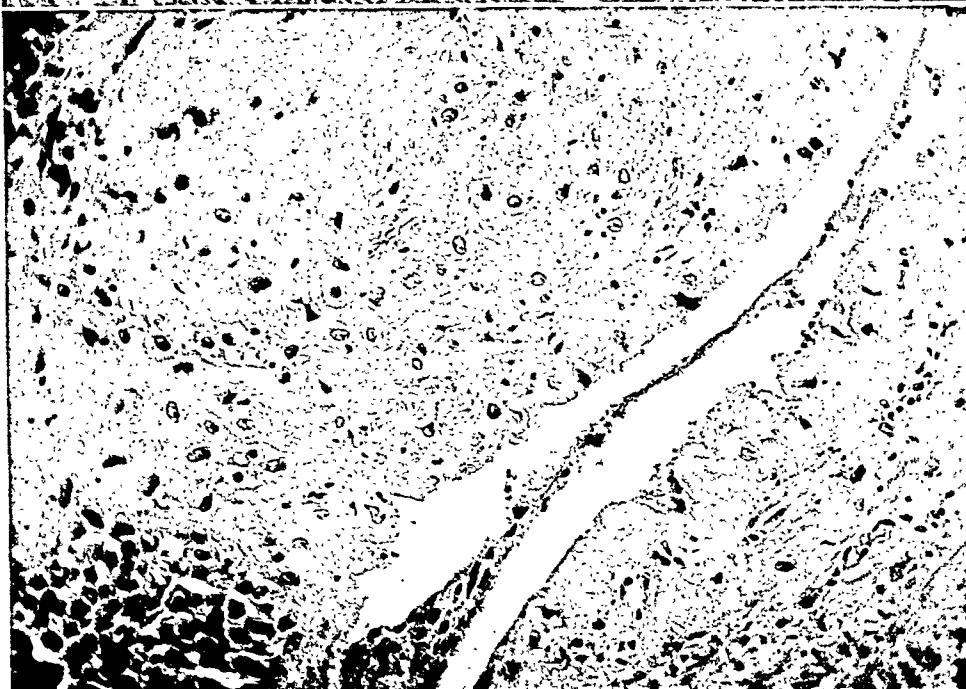


FIG. 8.

FIG. 7. Section through another portion of the placental mass, showing on the left one surface of broad ligament and on the right, chorionic villi, intervillous spaces, and blood clot. This area of broad ligament is made up of edematous fibrous tissue, scattered vessels and a moderately well demarcated zone of decidua cells. No serosal cells are visible, but a delicate layer of dense fibrin resembling a Nitabusch membrane tends to separate these decidua cells from the adjacent villi. Here the villi are collapsed, but they are still vascularized and apparently capable of functioning. Much of the intervillous space is filled with a moderately fresh coagulum.  $\times 108$ .

FIG. 8. Another section through the junction of broad ligament and placenta. A moderately dilated blood sinus divides the section diagonally and unevenly. This is lined with endothelium and bordered above, and on the left side, by decidua and below and on the right, by edematous ground substance and hypertrophied smooth muscle fibers infiltrated with lymphocytes and histiocytes. A small tongue-like mass of trophoblasts project into the lumen and another nest of trophoblastic cells is embedded among decidua cells in the lower left-hand corner of the section.  $\times 220$ .

vealed moderate vaginal bleeding and bulging and tenderness in the cul-de-sac of Douglas. A preoperative diagnosis of abdominal pregnancy

gutters were filled with free and clotted blood. The uterus was located. It was about twice its normal size; the left tube and ovary, were not

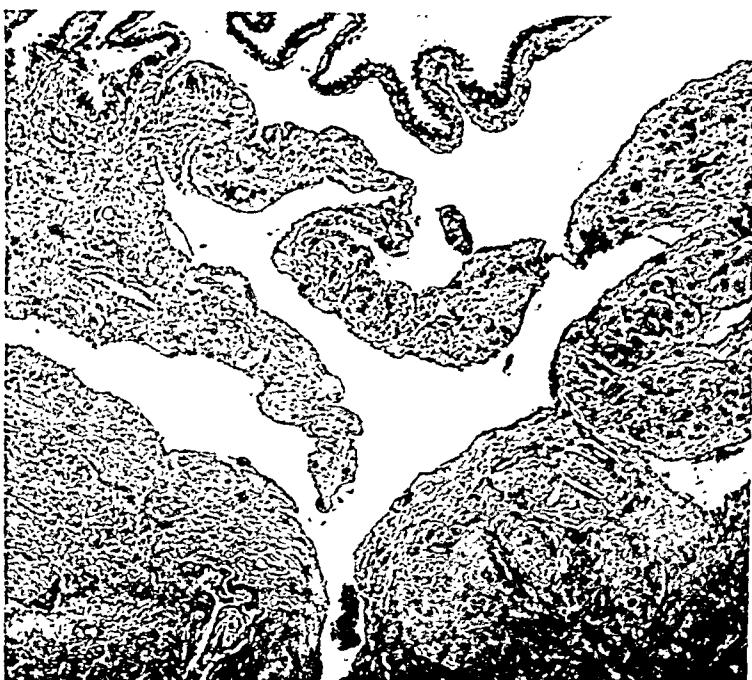


FIG. 9. A low power transverse section through a segment of tube. A narrow membrane of mucosa lies at the top of the field. This is partially separated from the underlying muscularis by large, communicating thin-walled sinuses. A mass of hypertrophied, smooth muscle fibers on the right and left border this sinus as it passes through the thickness of the tube. Below, two large clumps of fibrin, in which sclerosed chorionic villi are embedded, are almost inseparably attached to the tube. In this area, the wall of the tube is very thin and only the mucosa and blood sinuses separate the lumen of the tube from the peripherally attached placenta.  $\times 96$ .

had been made by Dr. T. G. Tighe, the resident surgeon. At the time of examination by the consultant it was evident that there was a severe intra-abdominal hemorrhage, and the preoperative diagnosis of abdominal pregnancy was allowed to stand. The improvement in her general condition having reached its optimum, operation was decided upon and the patient was taken to the operating room.

Spinal anesthesia was administered by Dr. Daniel Johnson, the hospital anesthetist. The urinary bladder was catheterized and the catheter was left *in situ*. The abdomen was prepared and the patient was placed in the Trendelenburg position. A median pelvic incision was made from the symphysis to the umbilicus. On entering the peritoneal cavity there was the escape of considerable blood, estimated at 500 cc. The pelvis and the lateral

enlarged, were adherent in the cul-de-sac of Douglas. On the right side there was a large mass which extended from that side of the uterus to the pelvic brim and rose above it. This mass contained an abdominal pregnancy, it was very tense, and, involved in this mass were the right side of the uterus, the right tube, the right ovary, the cecum, the appendix and the right broad ligament. In attempting to free the mass it was punctured, with the escape of amniotic fluid. A well formed, five months' female fetus, alive at the time of delivery, was delivered through the incision, and the cord was cut. The mass was shelled out from the posterior surface of the right broad ligament with the hand, the cecum and appendix were separated from it, but the right tube and ovary remained attached to it. The right infundibulo pelvic ligament was cut be-

tween clamps, the right broad ligament was clamped and cut under the mass until the right side of the uterus was reached, the tube

in two layers with a running suture of No. 1 chromic catgut in the peritoneum, and with through-and-through black silk sutures in the

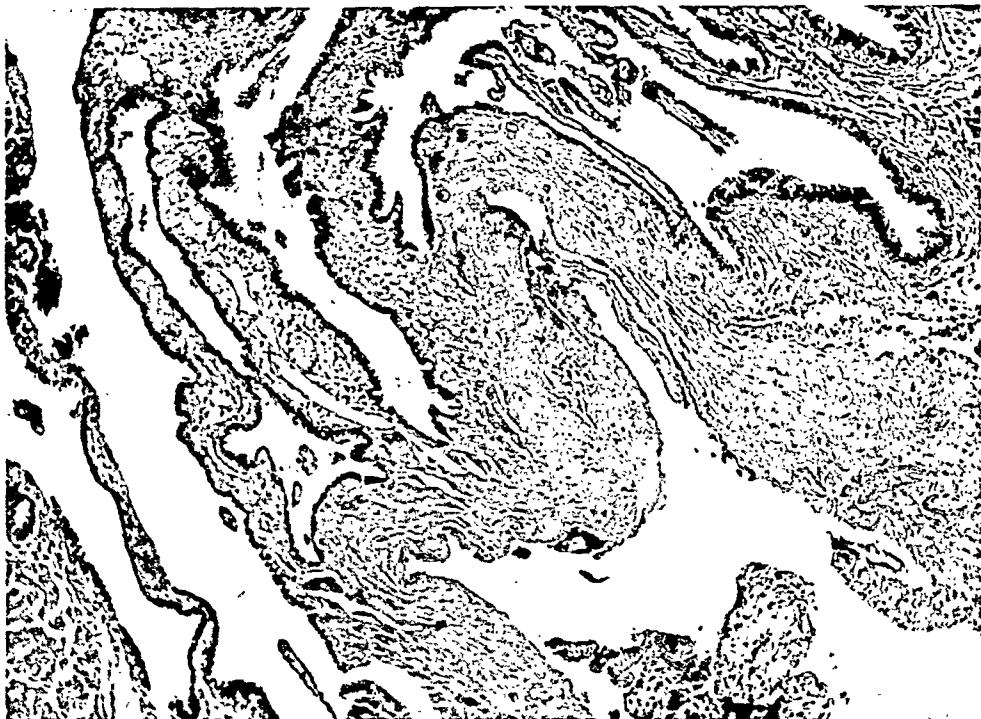


FIG. 10. A higher power magnification of a small segment of tube, showing the lumen divided up into numerous epithelial-lined spaces—a picture quite consistent with old, healed inflammatory reaction within the tube. In one area, just beneath the epithelium, there is a narrow zone of decidua cells and attached to this is an amorphous mass of fibrin. Large syncytial giant cells are embedded in the latter. This fibrin forms part of the boundary of a large intervillous space. In the lower right-hand corner of the section, several sclerotized chorionic villi project into this space. At this particular point in the tube, a layer of epithelium bordered externally by a narrow zone of decidua forms the only barrier between the lumen of the tube and the attached placenta. The smooth muscle in this area of the tube has entirely disappeared.  $\times 108$ .

and ovarian ligament were clamped close to the uterus and cut, and the mass was removed *in toto*. In addition to the tube and ovary the specimen contained a well formed placenta. All clamps were replaced with suture ligatures of No. 1 chromic catgut. Adhesions about the cecum and the appendix which had been severed were ligated with the same material. An area in the uterine fundus which had been bared during the dissection was covered over with serosa by means of a continuous suture of No. 1 chromic catgut. The hemostasis being complete, the blood clots in the pelvis and lateral gutters were removed but the liquid blood was left in the pelvis. The uterus was in forward position, the left adnexa, which had been freed from the cul-de-sac of Douglas, were left *in situ*, the omentum was spread over the intestines, which were distended, placed behind the uterus, and the incision was closed

remaining layers. At the completion of operation the condition of the patient was no more serious than it was at the start. Upon her return to bed she was given 500 cc. of blood plasma and 500 cc. of citrated blood by transfusion.

The convalescence was under the immediate supervision of Doctors S. P. Norman, and T. G. Tighe, Dr. Phaneuf seeing the patient only twice. Upon her return to bed, her temperature was 97°F., her pulse 150 and her respirations 34. On the first postoperative day the temperature rose to 101°F., the highest during her convalescence, the pulse was 130 and the respirations 40. At the sixth day all three had dropped to normal limits. She was allowed out of bed on the tenth day and was discharged on the thirteenth day, at which time the incision was well healed. She has remained well up to the present time.

The specimen was taken to Tufts College Medical School and submitted to Dr. H. Edward MacMahon, the Professor of Pathology, for examination. The report is as follows:

The specimens consisted of a female infant and placenta. The clinical diagnosis was abdominal pregnancy, fifth month.

*Specimen No. 1.* This was a well developed and well nourished white female infant, weighing 530 Gm., and measuring from head to heel 27.5 cm. Nails were formed on both hands and feet. The anus was patent. The eyelashes and eyelids were regularly formed. The head was round and symmetrical. The bones, the sutures of the calvarium, and the fontanelles bore a normal relationship to each other. The ears were fully developed, well formed, and lay flat against the head. The chest, abdomen, external genitalia, and extremities showed no evidence of disease. A segment of cord, 10 cm. in length, and 1.5 cm. in width, was normally attached at the umbilicus. *Gross Diagnosis:* A healthy female infant, approximately  $\frac{5}{9}$  months old.

*Specimen No. 2.* This was a placenta, together with 15 cm. of cord, weighing 275 Gm. The cord was regular in size, shape, color and consistency, and the cut surface presented the openings of three vessels, from which little fluid blood could be expressed. The fetal surface of the placenta was smooth, glistening, gray, and transparent, and was represented by the amnion, which could be easily detached from the underlying chorion. The placenta was nearly circular in outline and measured 20 cm. in diameter. For the most part it was thin and less than 1.0 cm. in thickness, but along one margin, it was coarse and thick, and measured 4 cm. in width. From this thick zone, the width rapidly tapered off as one passed from one side to the other, and where it was thinnest, it measured only 0.2 cm. The cord showed a solid marginal attachment, and joined the placenta at its thickest point. From here the vessels spread out in an irregular, fan-like manner. The vessels were small and inconspicuous and many were pale, collapsed, white, and empty. The maternal surface was very unusual. A small crescentric zone of grayish-red, friable, healthy chorionic villi, measuring about 2 to 3 cm. across, and 2 to 3 cm. thick, lay along one margin. This corresponded to the thickest portion of the placenta and also to the site of attachment of the cord. The remainder

of the maternal surface, measuring about 18 cm. in diameter, was represented by a comparatively smooth, but cobbled, gray to reddish-gray, firm, leathery, compact, membrane-like structure, that was inseparably attached to both chorion and villi. A very careful examination of this membranous, maternal surface, failed to reveal any recognizable structure, with the exception of a cluster of large blood vessels with thick walls and gaping lumina. These represented the distended and tortuous vessels of the broad ligament. Multiple sections through this area, which bordered the thickest portion of the placenta, revealed many more similar vessels, much edematous gray fibrous tissue, and an intact, but flattened ovary, and a completely hidden tube. The latter was tortuous, thick-walled, and 7 cm. in length. Both the inner and outer ends of the tube were discernible, and a 1 mm. probe could be easily passed through the outer two-thirds. The distal or outer end of the tube was represented by a gaping lumen that lay just at the junction between the friable and compact portion of the placenta.

Multiple sections into the ovary revealed a variable amount of edematous, gray, leathery, fibrous tissue, many vessels and several small cysts 0.3 to 0.5 cm. in diameter. There was no recent corpus luteum. On carrying these incisions more deeply through this gray, leathery, edematous, and vascular fibrous tissue of the broad ligament and ovary into the substance of the chorion itself, a narrow zone of villi and blood, representing the intervillous space, was recognizable in the thicker areas, adjacent to the attachment of the cord. The villi became less and less conspicuous, as one traveled farther from the cord, and in the thinnest portion of the placenta, they disappeared entirely. Here, only a narrow streak of coagulated blood separated the thin, flat, membranous chorion, from an equally thin, fibrous, maternal wall. It was obvious that less than one-third of the entire maternal surface of the placenta was composed of functioning chorionic tissue. This corresponded to the thickest portion of the placenta and was confined to that area radiating out from the attachment of the cord. This area came in contact with the upper portion of the broad ligament, the vessels of the broad ligament, the tube and the ovary. *Gross Diagnosis:* Ectopic

abdominal pregnancy, with placental site covering the broad ligament, ovary, tube, and pelvic peritoneum; old, healed salpingitis; follicular cysts of the ovary; hemorrhage into the decidua; widespread infarction of the placenta.

Microscopic examination was made of eleven sections taken from the cord, placenta and placental attachments.

Section No. 1. This comprised a portion of ovary, broad ligament, and placenta. The ovary was very edematous, and the stroma showed a number of old corpora albicantes. Along one surface, there was a layer of old, coagulated blood, in which the shadowy outlines of necrotic chorionic villi were still recognizable. There were many histiocytes filled with hemosiderin in this coagulum. The blood in the form of dense, closely packed fibrin, and fragmented and crenated red blood cells, came into immediate contact with those fibroblasts which formed the cortex of the ovary. These fibroblasts were abnormally large and were embedded in fluid, rich in old blood cells and fibrin. Practically all of these fibroblasts ran parallel to the surface of the ovary and there was little or no tendency for the fibroblasts or adjacent capillaries to extend into the adherent coagulum. There was a moderate infiltration of monocytes and lymphocytes into the underlying ovarian tissue. There were no viable, trophoblastic or syncytial cells and there was no suggestion of any ingrowth of villi into the substance of the ovary. In this area, there were no recognizable decidua cells. Diagnosis: Ovary and adjacent broad ligament, bordered by placental tissue showed so-called placental infarction.

Section No. 2. This consisted of ovary, chorionic villi, intervillous spaces and chorion. The ovary was edematous. Its arteries and veins were dilated and thick-walled. A dense layer of fibrin was adherent along one surface and embedded in this were chorionic villi. Some of these were necrotic, others were sclerosed. They contained few vessels and these were collapsed and empty. In areas, the intervillous spaces were filled with fibrin; in other areas, they were free. The syncytial cells were poorly preserved. There were scattered cells in the layer of fibrin adjacent to the chorion that resembled decidua cells. The chorion itself was sclerosed, and its vessels were partially occluded. The intervillous space

was unusually narrow. Diagnosis: Ovary, bordered by an area of completely and partially infarcted placental tissue.

Section No. 3. This comprised ovary, chorion, amnion, and a few degenerate non-functioning decidua cells. The ovary was edematous. The vessels were large. There was a layer of fibrin that separated a few hyalinized, collapsed villi, from the substance of the ovary. There were no free intervillous spaces. The chorion was narrow, sclerosed and avascular. The amnion was well preserved. There were a number of cells, resembling decidua cells, embedded in the fibrin, along the surface of the ovary. Diagnosis: Ovary and placenta: the changes in the chorion and villi here resemble those in the area of decidua reflexa of a normal pregnancy at about this period.

Section No. 4. This comprised the broad ligament, vessels of the broad ligament, and chorionic villi. Along one side, the broad ligament showed an old, chronic inflammatory zone of scar tissue. Along the other, there was a reasonably well defined zone of decidua cells, covered by a layer of fibrin. Adherent to the latter was a zone of sclerosed, but cellular, and poorly preserved chorionic villi. These had poorly defined vessels. The intervillous spaces were, for the most part, free. A striking change was seen in the vessels of this broad ligament. They were enormously dilated, and were bordered by smooth muscle fibers that showed an extreme degree of hypertrophy and hyperplasia. There is also a striking hyperplasia and hypertrophy of all of the smooth muscle fibers of that surface of the broad ligament coming into close contact with the placenta. There was no ingrowth of villi or trophoblastic cells into the tissues of the broad ligament. Diagnosis: Broad ligament, showing increased vascularity, hypertrophy of muscularis, and decidua cell formation, with attached, non-functioning, sclerosed, chorionic villi; old, healed inflammation of the broad ligament; chronic inflammation of the broad ligament.

Section No. 5. This consisted of the broad ligament. This showed massive hypertrophy and hyperplasia of the muscle fibers of the blood vessels. There were signs of old, healed inflammation. There was one fresh hemorrhage into the loose, edematous stroma. Diagnosis: Broad ligament, showing hemorrhage, edema, and vascular hypertrophy.

**Section No. 6.** This section comprised the broad ligament, tube and placenta. This section of tube showed a chronic inflammatory reaction of the wall, with extension to the surface as a chronic perisalpingitis. Along one side of the outer surface of the tube, there was a zone of decidua and a layer of fibrin. Embedded in the latter were few degenerate sclerosed, non-functioning, chorionic villi. *Diagnosis:* Chronic salpingitis and perisalpingitis, with attachment of non-functioning placental tissue along the serosal surface of the thickened tube.

**Section No. 7.** This comprised the tube, broad ligament and chorionic villi. The tube, in this area, showed signs of old, healed salpingitis, with adhesions between the villi and consequent partial obliteration of the lumen. The lumen of the tube was covered with an uninterrupted layer of epithelium, but the adjacent connective tissue and smooth muscle that form the wall were sharply interrupted in one area. At this site, the wall of the tube was thin, edematous, and rich in large, gaping, blood sinuses, and clusters of decidua cells lay in the mucosa and in the adjacent wall. A single layer of epithelial cells was the only barrier separating these decidua cells from the lumen of the tube. There was considerable old blood, coagulated in and about this area, and functioning and non-functioning, sclerosed, chorionic villi were deeply embedded in both this decidua tissue and blood clot. Peripherally, this defect in the wall was partially filled with placental tissue, which became continuous at the surface of the tube with a layer of fibrin, decidua and villi covering the broad ligament. *Diagnosis:* Ectopic tubal pregnancy with extension of the pregnancy through the mucosa into the wall and with growth of the placenta both within the wall of the tube and along the adjacent broad ligament; old, healed salpingitis.

**Section No. 8.** This comprised the broad ligament and organizing blood clot. This section was taken in one of the thinnest portions of the placenta. The broad ligament showed a definite chronic inflammatory reaction in this area. There was considerable hemorrhage showing signs of organization. There were no decidua and no villi. *Diagnosis:* Broad ligament, showing chronic inflammation, organizing blood clot.

**Section No. 9.** This consisted of the broad ligament and placenta. This section, like the

last, was taken in the thin portion of the placenta, and included its entire thickness. The broad ligament was bordered along one side by old, organizing bloodclot in which were embedded degenerating chorionic villi. The chorion was narrow and sclerosed. *Diagnosis:* Broad ligament, showing infarction of villi and organizing hemorrhage.

**Section No. 10.** This specimen was of the chorionic villi. This section was taken through the chorionic villi in the thickest portion of the placenta. The villi were healthy, mature, and showed normal vascularity. There was no suggestion of erythroblastosis. *Diagnosis:* Healthy chorionic villi, entirely free of disease.

**Section No. 11.** This section was the cord. This is a cross-section, taken through the cord, several centimeters from its placental attachment. The three vessels were well formed and bore a normal relationship to each other. The bordering tissue was quite regular in all respects. *Diagnosis:* Cord, showing no evidence of disease.

#### SUMMARY

From a review of the above descriptions and diagnoses, it is apparent that this represents an abdominal ectopic pregnancy, apparently originating within the tube. The development of the placenta had taken place principally within the wall of the tube and along the surface of the tube, ovary and broad ligament.

The tube and ovary were the seat of an old, healed inflammatory reaction in which the lumen of the tube had become partially obliterated. There was still a mild chronic inflammatory reaction in portions of the broad ligament.

The cord and the amnion and the chorionic membrane and chorionic villi adjacent to the attachment of the cord were healthy, mature and free of disease. The chorionic villi in this portion of the placenta were loosely attached to the broad ligament in the region of the tube and ovary. In this area, there were well developed intervillous spaces, bordered by chorion on the one hand, and by fibrin, decidua, and smooth muscle fibers of the broad ligament, on the other. There was a hypertrophy and a

hyperplasia of the smooth muscle fibers of the broad ligament, and of the vessels of the broad ligament, especially those in the immediate vicinity of the attachment of the placenta. The vessels here were large, dilated, and gave rise to broad, thin, endothelial lined sinuses, bordered by edema fluid, fibroblasts and decidua. Chorionic villi and nests of trophoblasts were found within the lumina of some of these thin-walled sinuses. The decidua, connective tissue stroma, smooth muscle fibers of the broad ligament, and the dilated and hypertrophied vessels represented the functioning portion of the maternal placenta. The remainder of the placenta was thin, and for the most part, non-functioning, and was composed of a compact layer of chorionic villi that showed degeneration and necrosis, fibrin, and bloodclot. This

portion of fetal placenta was attached to portions of the broad ligament and pelvic peritoneum and to the surface of the ovary by dense fibrin, which showed very little attempt at organization. There was no evidence of malignancy.

#### COMMENT

There are several points of unusual interest in this case. First, the abdominal pregnancy itself; secondly, its probable origin from within the tube; thirdly, the ectopic decidua cell reaction along the surface of the broad ligament; fourthly, the striking hypertrophy and hyperplasia of smooth muscle in the immediate vicinity of the functioning chorionic villi,—which suggests a hormonal stimulus to growth, and lastly, the lack of invasion of the villi in areas devoid of decidua.



THE course of the large intestine affected by thrombo-ulcerative colitis is relatively straight and the angles at the flexures approximate right angles. From a soft, pliable, thin walled, gently winding, and twisting tube, it has become a hard, inflexible, stiff, thick walled, straight pipe with a small lumen somewhat analogous in form and general appearance to a thick walled, tense sclerotic artery.

# REGIONAL ILEITIS\*

## MANAGEMENT OF COMBINED INVOLVEMENT OF DISTAL ILEUM AND DISTAL COLON

MAJOR LOUIS P. RIVER, M.C., A.U.S.,  
Surgeon, Station Hospital, Tarrant Field  
FORT WORTH, TEXAS

JOHN W. HOWSER, M.D.  
Associate Attending Surgeon, Cook County Hospital  
CHICAGO, ILLINOIS

AND  
ARKELL M. VAUGHN, M.D.  
Attending Surgeon, Cook County Hospital  
CHICAGO, ILLINOIS

DESPITE the contention of Maingot<sup>1</sup> that Combe<sup>2</sup> is to be credited with the first description of terminal ileitis, the present concept of the disease is based upon the paper published by Crohn<sup>3</sup> in 1932, after observing fourteen cases. These were clinically and pathologically similar. In each the involvement was of the terminal ileum by a non-specific granuloma with predisposition to the formation of internal and external fistulas and finally to stenosis of the affected and involved segment.

Harris, Bell and Brunn<sup>4</sup> in 1933, reported jejuno-ileitis as a similar disease; Brown, Bargen and Weber<sup>5</sup> included both forms under the term regional enteritis. Colp,<sup>6</sup> in 1934, described another form in which the small bowel involvement was accompanied by an inflammatory, ulcerative colitis, with symptoms and course at variance with those of involvement of ileum alone.

At first, Crohn<sup>7</sup> was unwilling to accept this new disease as due to the basic condition described in 1932. Crohn based this disbelief upon the fact that in all the cases originally described, the lesion involved the terminal eight to ten inches of the ileum, ending abruptly at the ileocecal valve. In addition, he cited examples in which a diseased ileum had been anastomosed to a healthy colon, and the colon had remained

free of involvement even after sixteen years. However, he reported nine cases of a combined type of regional inflammation, an involvement of the small and large intestines, the ileum reacting as a granuloma, the colon reacting as an ulcerative and hyperplastic colitis.

Such a combined type of disease, according to Crohn, is not usually sequential but synchronous. Sometimes, however, it seems as if the disease had been primary in the ileum and spread to the colon secondarily.

It must be pointed out that a severe ulcerative colitis may extend to involve the terminal ileum. Such a condition has been well shown by the work of Henke and Lubarsch,<sup>8</sup> Bargen, Buie and Rankin,<sup>9</sup> as well as Klemperer.<sup>10</sup> They place the incidence of such an extension at about 25 per cent of all cases of colitis.

All of these writers are agreed that although extension may occur from the colon to the ileum, the extension is by backwash through the ileocecal valve, and the process in the ileum in ulcerative colitis is destructive and denuding, as in the colon, and not hyperplastic and granulomatous, as in primary ileitis. The clinical picture is one of colitis and not of ileitis.

Crohn gives the typical description of the combined form of primary ileitis and colitis in his later paper which is quoted as follows. "An ulcerative, granulomatous

\* From the Department of Surgery, Loyola University Medical School, and Cook County Hospital, Chicago, Illinois.

inflammation of a severe type involves the terminal ileum, and scattered and interrupted segments of the colon, or the con-

dition may be seen in the later stages through the sigmoidoscope when the extension has proceeded to the terminal colon. The differ-



FIG. 1. Barium enema showing appearance of involved terminal ileum and distal colon; after exclusion.

tiguous cecum and ascending colon. The clinical picture is essentially that of an ileitis which must be considered the dominating factor and as contributing to the main clinical features. The onset is usually stormy and febrile with high temperature, abdominal pain, and a low grade diarrhea with from two to three movements a day. The course soon becomes chronic, debilitating and emaciating. The entire pathologic process may subside after many months, with complete restoration to health, or resection of the ileum and the contiguous ascending colon may be followed by a subsidence of the colitis and cure. Resection of the colon is not mandatory, removal of the diseased ileum, not in part, but in whole suffices to allow complete subsidence of symptoms. The involvement of the colon in the picture may be seen at the exploratory operation, or may be reported roentgenologically by barium enema, or it



FIG. 2. Barium enema showing fistulous tracts between involved areas in distal colon; before exclusion.

entiation from primary ulcerative colitis is made on the basis of the lesser severity of the colonic involvement, the mild degree of diarrhea at the onset and the presence of the predominant lesion in the ileum, namely, a mass in the right iliac fossa, abdominal cramps and eventual ileal stenosis. Fistula formation is rare in this combined form. The etiology is not known."

Ginsburg and Garlock,<sup>11</sup> in a resume of the decade of experience at Mt. Sinai Hospital, state that of the three similar lesions included under the name regional enteritis; i.e., jejuno-ileitis, distal ileitis, and the ileocolic form of right-sided migratory colitis, the first is definitely non-surgical. They also show that exclusion without resection gives satisfactory results in distal ileitis. Certainly none of those who have reopened the abdomen to resect

the formerly massively infiltrated segment can have failed to be impressed with the subsidence of infiltration and adherence following exclusion.



FIG. 3. Resected specimen in case of combined involvement of distal ileum and distal colon.

In the case here reported, the retroperitoneal ileosigmoid fistulas did not heal on exclusion, the cecum apparently became involved after the exclusion, and the disease persisted in the rectosigmoid long after resection of the original involved ileum and exclusion of the rectum.

#### CASE REPORT

Mr. E. C., a white male, age twenty-one, No. 40-27569, was admitted to the Cook County Hospital on May 14, 1940. At this time he was complaining of vague intermittent pains in the abdomen for seven days. These pains had localized to the right lower quadrant five hours prior to admission. There was no associated diarrhea or constipation. He did vomit five times during the day before admission. Essential physical findings at this time were limited to the abdomen, and consisted of tenderness in the right lower quadrant, with no abdominal palpable mass. Occasional rushes and tinkles were heard. Rectal examination was negative. The white blood count was 13,600; hemoglobin 90 per cent; urine negative, temperature 98.8°F.; pulse 80; respirations 20. A diagnosis of acute appendicitis was made and operation performed. The note made by the surgeon follows: "Appendix

encased in a mass of omentum about the size of an orange. Free fluid present in the peritoneal cavity, the terminal ileum much inflamed. The abdomen was opened with a McBurney incision, the mass noted as above and the abdomen closed without removing the appendix." The postoperative course was uneventful and the patient left the hospital on the eighth postoperative day.

Ten months later, March 27, 1941, he came under our care on readmission to the Cook County Hospital, No. 41-17104. The history on this admission was as follows: He stated that he had been ill for over a year with vague lower abdominal crampy pain. In addition he had had postcibal pain, referred to the right and left lower quadrants, regardless of the kind of food eaten. He had lost thirty-five to fifty pounds in the last six months, and had become gradually weaker and emaciated. In the last month, he had had a watery diarrhea, with three to four movements a day. The stool had contained no gross blood. The abdomen was scaphoid, no rigidity or masses palpated. Tenderness was present on deep palpation in the midline between the xiphoid and pubes. Bowel sounds were hyperactive with occasional rushes and borborygmi. The prostate was firm and no other mass was palpable.

The provisional diagnosis was ulcerative colitis, to consider enteritis. After the previous chart was obtained and it was seen that in the previous operation the inflamed terminal ileum was noted, with a right ileal mass, the diagnosis was thought to be regional enteritis. The stools examined repeatedly contained no blood. Proctoscopy showed at 10 cm. a hard, irregular friable ulcer involving the left posterior quadrants. A punch specimen was taken for biopsy. Urine was negative; chest plate was negative. After a barium enema the following was reported: "There is a rigid, irregular filling defect of the distal portion of the sigmoid colon, with multiple sinus tracts extending from this point. The lumen is markedly narrowed. The terminal ileum is also markedly narrowed and irregular, with sinus tracts arising from this area, some of which apparently join the tracts arising from the sigmoid colon, thus giving rise to fistulous tracts between the ileum and sigmoid. The findings are diagnostic of a regional enteritis."

Preoperative management included transfusions of blood, vitamins, adequate diet and

hydration. At operation on April 18, 1941, the findings were as follows: Twelve to fifteen inches of the terminal ileum, were involved in a densely adherent mass with the pelvic colon and rectum. The cecum was uninvolved as was the proximal ileum and jejunum. Many almond-sized firm glands were in the mesentery. The serosa of the involved ileum was still somewhat shiny, but the wall was many times thickened. A right rectus displacing incision was made. The proximal loop of healthy ileum was brought six inches out the upper end of wound, and put through a slit in the muscle. The wound was closed in layers with interrupted silk. A full thickness free skin graft from the right thigh was put around three inch loop of ileum as a sleeve, and sutured to the abdominal wall. The donor site was closed with interrupted silk. Two days later the ileostomy was opened and a catheter placed in the proximal limb. The limbs were divided on the tenth day. The patient made an uneventful recovery. On May 13th, sigmoidoscopic examination revealed a friable ulcerated mass at 10 cm. on the left posterior area. From this there were several fistulous tracts, their bases easily evident, from which might be expressed a thick yellow drainage. This looked less acute and inflamed than when we saw it previously, however. Biopsy of area showed an actively inflammatory lymphoid follicular polyp; there was no evidence of malignancy. Biopsy of abdominal lymph node revealed non-specific hyperplasia with marked proliferation of the reticulum in the secondary follicles.

The patient left the hospital on May 14th, gaining in weight and strength and with his ileostomy functioning well, retained by a colostomy bag.

On October 1st, he was again admitted to the Cook County Hospital, No. 41-55670, having been told to report at this period for further examination and treatment. During the interim he had, in a period of six months, gained thirty pounds, and had had no further abdominal cramps. He had had some mucoid, blood tinged drainage from the rectum during this time. Essential physical findings were the ileostomy openings at the apex of the skin tube in the right mid abdomen, and the rectal induration with the seromucopurulent drainage. The abdominal skin was normal, ample reward for the trouble in making the skin tube.

Sigmoidoscopic examination revealed that between 10 and 20 cm. the mucosa was ulcerated and contained openings of several fistulous tracts. The mucosa was reddened and hyperemic. The impression was that of an ulcerative proctitis secondary to enterofistulas from adjoining regional enteritis.

To continue the defunction of the rectum after the segment of ileum was resected, a loop colostomy of the sigmoid was performed under intercostal block on October 6th; this was opened on October 31st. A Frei test was negative at this time.

On October 20th, under spinal nupercaine, a vertical incision was made excising the ileostomy. The terminal twenty inches of ileum, which had been indurated and sausage-like at the previous operation, was now small, thickened and matted together. The cecum was thickened and small. The mesentery of the ileum had glands enlarged, almost to the root. The terminal ileum was twisted on its self, and attached to the cecum, suggesting internal fistulous tracts between the ileum and cecum. The rectosigmoid was firmly attached to the posterior pelvic wall. No obvious communications were seen between loops of terminal ileum and rectum. A right hemicolectomy, including the distal twenty-four inches of ileum was performed. An isoperistaltic ileotransverse colostomy with two rows of interrupted silk sutures was performed. Layer closure, without drainage; with interrupted silk was done.

A description of the resected specimen, by Dr. A. B. Ragins follows: "Resected portion of an ileostomy wound closed by black silk, communicates with proximal loop of ileum measuring 15 mm. in diameter, also with the terminal portion of the ileum which measures 35 cm., the cecum, ascending colon and proximal part of transverse colon; 15 cm. from the distal ileostomy opening, the loop of the ileum shows a u-shaped defect. The top of this defect is composed of a dense fibrous tissue. The terminal 14 cm. from the ileocecal junction medialwards shows a marked thickening of the wall, the serosal aspect is darker purple red than the purple red of the normal mucosa. The wall is up to 4 mm., light grey. The mucosa is edematous, attached to the underlying tissue and is slightly granular. The remaining loop of ileum extending to the distal ostium of the ileostomy wound, light pinkish grey, the wall 2 mm. thick, the mucosa pink grey and folds

are distinct. At the top of the u-shaped defect there is formed a small traction diverticula measuring 12 mm. in length. But this diverticulum does not communicate, although it is firmly adherent by fibrous connective tissue bands to the distal most portion of the ileum which forms the other prong of the u-shaped defect. The lymph nodes of the mesentery are up to 12 mm. in diameter, light purple in color. The follicles of the large bowel are distinct and the mucosa of the bowel is studded with numerous pinpoint to pinhead sized hemorrhages. The appendix measures 5 x 4 x 6 cm. and on section through the tip, the lumen is markedly narrowed. Microscopic: Specimen of terminal ileum at the site of construction reveals the mucosa to be superficially ulcerated and markedly infiltrated with numerous round cells, which extend to the thickened submucosa. The muscularis propria is but moderately infiltrated by round cells, and the subserosa shows marked infiltration. This microscopic picture is in keeping with the diagnosis of regional enteritis. Section of a lymph node shows a non-specific inflammatory hyperplasia."

Following this procedure, the patient made an uneventful recovery and was discharged on November 12th, having four to five watery stools daily through the colostomy. On November 10th, sigmoidoscopic examination had shown considerable scarring of the mucosa, and at 12 cm. on the right posterior there was seen a definite fistulous tract covered by a large inflammatory polyp. Above this up to the sigmoid there was irregular scarring and several small inflammatory polyps. The mucosa of the sigmoid was fairly normal.

On March 30, 1942, he was again examined. He entered the hospital desirous of having the colostomy closed. He had been free from pain and of discharge from the rectum since the last operation, had continued to gain weight, and now weighed more than prior to his illness. Sigmoidoscopic examination revealed a thickened rectal mucosa and many inflammatory polyps. Biopsy of the largest of these revealed only non-specific inflammatory hyperplasia. A barium enema passed freely through the distal colon and out the distal limb of the colostomy. It was decided that the sigmoidostomy could be closed. On April 13th, under 125 mg. of 10 per cent procaine intrathecally, the stoma was excised and the skin freed. The fascia was exposed all around, the peritoneum not

opened. The serosa of the bowel was cleared of fat and epiploic appendages, and closed transversely with two rows of interrupted silk. This was then reduced under the fascia, and the fascia imbricated with silk, and the skin closed. Sulfathiazole, 30 gr., were placed in the wound.

The patient left the hospital on April 28th, having watery to soft stools. The colostomy seemed to be closed. He was instructed to report monthly for recheck. After two months, the colostomy had begun to leak at intervals. Another attempt at closure was made July 31st. He returned in November, 1942, leaking from a small sinus again, and was admitted in January, 1943, and reoperated upon February 2, 1943.

Under spinal nupercaine, a longitudinal incision was made lateral to the fistula and the peritoneum opened by intention. The sigmoid loop was cleared and the fistula followed to the abdominal wall. The tract was excised and the bowel closed with two rows of interrupted silk, at right angle to the longitudinal axis. Inasmuch as several efforts had been made to close this fistula, it was feared that the lumen would be constricted, and a primary sigmoido-sigmoidostomy was effected between the afferent and efferent limbs of the sigmoid. This was done with two rows of interrupted silk. Sulfanilamide, 60 gr., were placed in the abdomen, and the wound closed in layers without drains. The wound healed by primary intention, and the patient left the hospital, following an uneventful recovery, on February 15, 1943.

At the time of this patient's discharge, he was having normal bowel movements through the rectum, and had gained over fifty pounds from that of the entrance weight on March 27, 1941. Sigmoidoscopic examination showed at the old fistulous sites evidence of granulation, and reddening of the mucosa, but no fistulous tracts or openings, and no discharge into the lumen of the rectum.

This case is of interest from the standpoint of the length of time necessary to effect a cure, almost two years. We became discouraged at times with the course, and with the necessity of having to do graded, stage operations. We believe now that if we had originally opened the peritoneum to close the subsequent sigmoid fistula, the course of treatment would have been shortened, but we were hesitant to do this until the last attempt. The probability is

that this patient had now so much resistance to his intracolonic organisms, that the peritoneal cavity could easily have tolerated almost any intra-abdominal primary procedure.

This patient has been followed at weekly intervals, and there is no further evidence of any more fistulous tracts, the abdominal fistula is closed and the abdominal wall well healed. He is now in the army, having passed the physical examination necessary for induction.

#### SUMMARY

1. The close relationship between terminal ileitis as first so named by Crohn, jejuno-ileitis, ("skip" lesions) and combined terminal ileitis and colitis is briefly discussed. It is noted that the first type in which fistula formation is commonest, is now believed to be best treated by exclusion without resection.

2. A case of terminal ileitis is reported in which ileosigmoid fistula formation followed exploratory operation only. The ileal granuloma, but not the fistulas, and the rectosigmoid ulceration only slightly regressed after exclusion.

3. The operative stages in defunctioning and excision of the involved areas were: (a) end ileostomy, (b) sigmoid colostomy, (c) right hemicolectomy, including involved

ileum, (d) closure of the sigmoidostomy, involving sigmido-sigmoidostomy.

4. The treatment of such conditions is resection; to obtain a satisfactory result by graded operations may take up to two years; the period in which new lesions, if they are to occur, may be expected.

#### REFERENCES

1. MAINGOT, RODNEY. *Abdominal Operations*. New York, London, 1940. Appleton-Century.
2. COMBE. A singular stricture and thickening of the ileum. *Tr. Roy. Coll. Phys.*, 4: 16, 1813.
3. CROHN, B. B., GINZBURG, L. and OPPENHEIMER, G. O. Regional ileitis. *J. A. M. A.*, 99: 1323, 1932.
4. HARRIS, F. I., BELL, G. H. and BRUNN, H. Chronic cicatrizing enteritis. *Surg., Gynec. & Obst.*, 57: 637, 1933.
5. BROWN, P., BARGEN, J. A. and WEBER, H. M. Chronic inflammatory lesions of the small intestine. *Tr. Am. Gastro-Enterol. A.* p. 2, 1934.
6. COLP, RALPH. A case of non-specific granuloma of the terminal ileum and the cecum. *Surg. Clin. North America*, 14: 443, 1934.
7. CROHN, B. B., and ROSENAK, B. D. A combined form of ileitis and colitis. *J. A. M. A.*, 106: 1, 1936.
8. HENKE and LUBARSCH. *Handbuch der Speziellen Pathologie Anatomie und Histologie*. Berlin, 1928.
9. RANKIN, F. W., BARGEN, J. A. and BUIE, L. A. *Diseases of the Colon, Rectum and Anus*. Philadelphia, 1932. W. B. Saunders.
10. KLEMPERER, PAUL.<sup>7</sup>
11. GINZBURG, L. and GARLOCK, J. H. Regional enteritis. *Ann. Surg.*, 116: 906-912, 1942.



# SUBSCAPULAR OSSIFIED HEMATOMA\*

## CASE REPORT

MAJOR J. WILLIAM WHITE  
Medical Corps, Army of the United States

AND

MAJOR SYDNEY HUTNER  
Medical Corps, Army of the United States

CAMP JOSEPH T. ROBINSON, ARKANSAS

**A**CIRCUMSCRIBED collection of effused liquid or clotted blood in the tissues, their interstices, in serous or non-serous cavities constitutes a hematoma. In other words, a hematoma is a confined hemorrhage in which clotting may or may not have taken place. Although restraining influences are admittedly present, the implication that the effusion is always self-limiting or inherently controlled is contradicted by the frequency of local recurrence and regional extension.

Liberally viewed, hematomas range in size from pin-point dimensions (petechiae) to ponderous volumes. Ecchymoses differ from petechiae in being larger and confined to the skin, but they are actually hemorrhagic effusions.

Classification according to source, physical features, anatomic site, pathologic characteristics, and period of existence tends to simplify description. Therefore, a hematoma may be referred to as acute, postoperative, diffuse, subcutaneous, infected, or in analogous applicable terms. The acute stage is arbitrarily considered to last three weeks and the chronic indefinitely thereafter.

Hemorrhagic accumulations in serous cavities, although hematomas in fact, are designated hematoceles, hematocysts and blood cysts, or they are given appellations of specific localization, namely, hemothorax, hemoperitoneum, hemarthrosis, and equivalent titles. In some instances, particularly when liquefaction has taken place, they are termed hydromas or hygromas.

Hematomas appear spontaneously in consequence of dyscrasia, from the dis-

solution of a degenerated blood vessel and as an effect of constitutional disease. More often, however, they arise primarily from trauma, which is usually of a contusing or crushing nature, or secondarily from extrusion of a thrombus, the release of an insecure ligature, the failure to seal a venopuncture or from capillary leakage. Conspicuous sources of hematomas currently are attributable to warfare: the disruptive impact of fragmented projectiles, the division of vessels by penetrating missiles, the effect of vigorous traction induced by centrifugal force within the radii of powerful explosions, the bruising, rending and torsion of structures consequent to obstacle course training and the severe crushing injuries sustained in vehicular accidents. Fracture and dislocation of the subjacent bones are liable to occur when violence is a factor and a hematoma may form from the site of fracture or from the forcibly separated contiguous tissues.

The fate of hemorrhagic accumulations is variable. When small and uncomplicated, they are accompanied by few if any symptoms and tend to resolve quickly. Treatment then is a minor consideration. Hematomas of larger proportions, however, are usually symptomatic although they may be the hidden complement of more obvious and serious lesions. Where injury is extensive, and particularly in deep lying regions, the hematoma may be completely obscured. The diagnosis then will depend upon the pathognomonic syndrome produced, as, for example, is the case in extradural hematoma, or upon subsequent developments as shown in

\* From the Surgical Service, Station Hospital, Camp Joseph T. Robinson, Arkansas.

the succeeding case report. Contingent upon location, associated conditions and complications, the treatment may be simple or involved.

presumed that they were present for a brief interval, at least, before their acquisition of an opaque quality. Serial x-ray pictures of ossifying hematomas show a



FIG. 1. X-ray plate showing subscapular ossified hematoma compressing ribs.

Collections of blood which are not successfully evacuated pass through phases similar in some respects to the process of tissue repair, i.e., resolution, fibrosis, suppuration or, in rarer instances, ossification. Resolution may be delayed or interrupted. Failure in absorption results in the persistence of an hydromatous cyst. Because of the propensity of hematomas to become infected, a considerable number progress to abscess formation. Aspiration or excision, or incision and drainage are indicated, respectively, in either of the latter eventualities.

Ossification, an abstruse phenomenon, occurs with greatest frequency in hematomas about the elbow joint and in the thigh. Often manifested as a later transition product, calcium deposits have been demonstrated roentgenographically early in the third week following injury; and it is

progression from flocculated calcium islets to complete replacement by lamellations of compact and cancellous bone. Eventually, the inflammatory barrier found at the periphery of hematomas is converted into a neomembrane, grossly resembling periosteum and serving as a capsule at the circumferential limits of ossification.

The primary objective in the treatment of ossified hematoma should be prevention. Experience has shown that aspiration and evacuation of simple hematomas are inconstant but likely sources of infectious contamination. Relative rest, passive motion, heat, diathermy, and massage are of benefit to an indeterminate number of patients in whom local calcification is of recent origin. In others, surgical excision may offer the only means of relieving disability. Recurrences after operation are fairly common either because ossifica-

tion was incomplete at the time surgery was instituted or because of the trauma incidental to operation.

case report reveals the advanced degree of ossification that may ultimately take place in a hematoma and the signs of

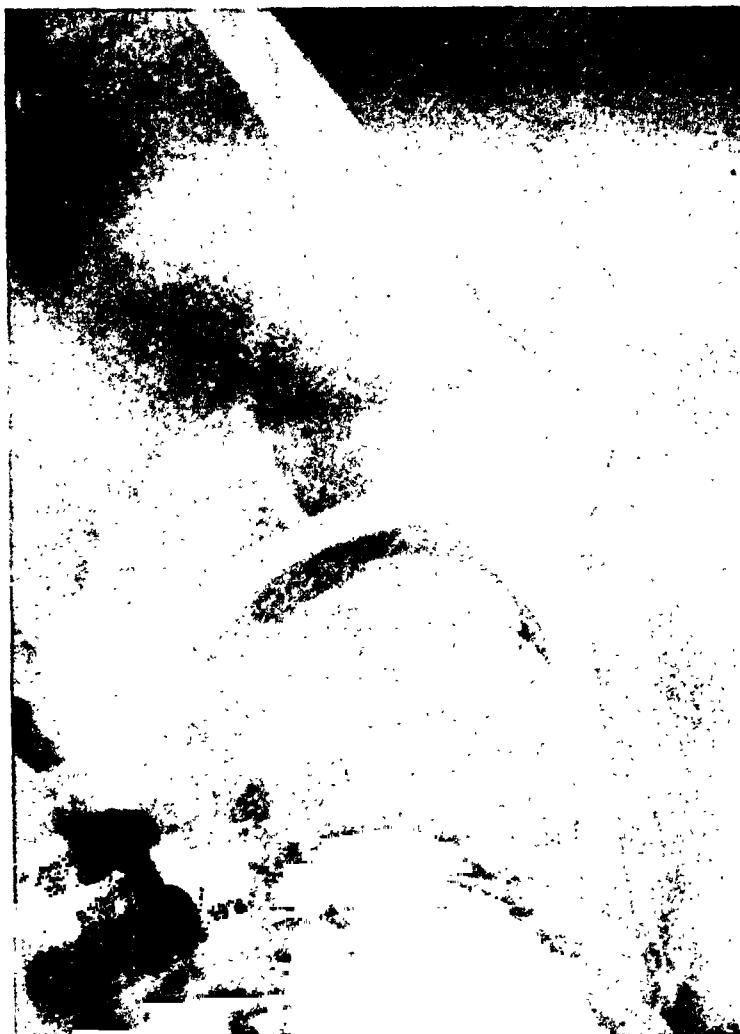


FIG. 2. X-ray plate showing ossified hematoma and diodrast injected vein.

The optimum time for surgical intervention has not been clearly defined. Too early removal may result in recurrence or extension of calcification; too late, in permanent pressure damage to adjacent vessels and nerves. Even though successful extirpation has been accomplished within three months of injury, it is perhaps more prudent to recommend waiting a year before making an attempt to excise an ossified hematoma, provided, of course, that relief from neurovascular symptoms is not indeed more urgent. The appended

nerve degeneration that may result from pressure if operation is too long deferred.

#### CASE REPORT

R. W. D., No. 47192, a white army private, was admitted to the Station Hospital, Camp Joseph T. Robinson, Arkansas, March 20, 1943, complaining of a "lump in the right shoulder with numbness and tingling of the right hand."

The family history was negative for hemato-pathology and details of the past history were irrelevant.

The present illness was initiated twenty-two years previously when a severe crushing injury to the right shoulder was sustained in a fall

of the right supraclavicular fossa. An arterial pulsation was visible and palpable for a distance of approximately 7 cm. transversely between



FIG. 3. Ossified hematoma specimen not magnified.

beneath a thrown saddle horse. Treatment was promptly instituted and a plaster jacket worn for the succeeding three months. A similar period was devoted to physiotherapy in an effort to relieve persistent numbness of the right hand. Thereafter a cock-up splint was applied to the forearm and hand which were thusly supported for one and one half years. Sensory phenomena persisted, but the presence of a localized swelling above the clavicle and in the axilla was not discovered until several years after injury. The tumefaction was not believed to have increased in size although its presence was observed for fourteen years.

Physically, the patient was apprehensive, fair skinned, slightly pale and well nourished. The right hand was continually supported in the opposite palm and the arm was maintained at a twenty degree angle of abduction. The vertebral border of the corresponding scapula was rotated posterolaterally. The thorax was symmetrical, but there was an ovoidal fullness

the clavicular and sternal divisions of the right major pectoral muscle. These pulsations corresponded with the heart rate and were easily compressible. They disappeared when the arm was elevated above a right angle. A local bruit was not present, although at the cardiac apex there was a soft, untransmitted systolic murmur. Pain, which radiated along the ulnar surface of the arm and forearm was induced by elevating the arm above shoulder level and by elevating the chin forcibly while the head was rotated toward the side of the lesion. An obliquely directed ovoidal, non-tender, solid, regularly surfaced tumor, movable vertically, medially, and laterally within narrow limits, occupied the right subscapular, axillary, and supraclavicular fossae. The overlying skin was not inflamed nor was it adherent to subjacent structures. Forceful pressure mediosuperiorly in the depths of the axilla induced local pain and increased the tingling sensation along the ulnar nerve distribution of the forearm and hand.

Neurologically, there was hypesthesia of the dorsal and ventral aspects of the medial half of the right fourth and total fifth fingers. The

Other pertinent laboratory studies were of no assistance either in the diagnosis or treatment. On March 30, 1943, the tumor was removed

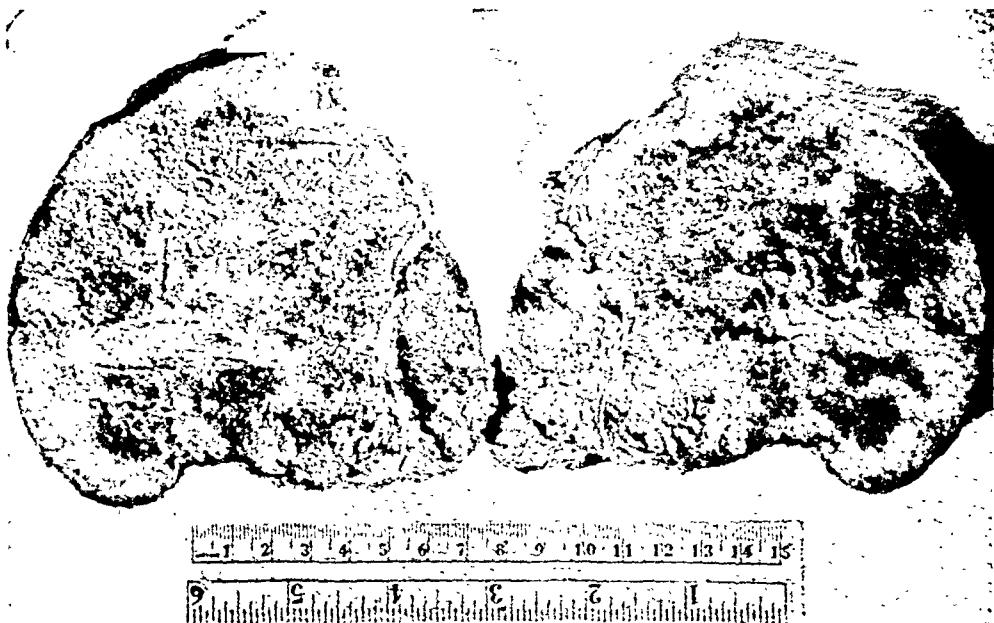


FIG. 4. Sagittal section of ossified hematoma not magnified.

sensory impairment extended over both surfaces of the hand and forearm to approximately 6 cm. above the ulnar carpal joint. Segmental involvement of the eighth cervical and first dorsal nerves indicated that elements of the ulnar and median nerve branches were involved in the pathologic process through compression of the medial cord of the brachial plexus. However, there was no loss of reflexes and no muscular atrophy. Likewise, vascular phenomena were not evident, there being no ischemia, cyanosis, mottling, or edema.

Stereoscopic x-ray plates showed a large, irregular, calcified mass measuring approximately 14 by 6 cm. located between the scapula and the thoracic wall. The mass was sharply demarcated from the surrounding soft tissues and was not attached to any bony structure, although the upper four right ribs were flattened against the lateral lung surface, thus narrowing the costal cage, and the scapula was moderately displaced backward. Impression: Calcified hematoma.

A tangential view after the injection of 30 cc. of diodrast into the median basilic vein revealed satisfactory visualization of the basilic and axillary veins. The axillary vein was displaced anteriorly and 1.5 cm. above the calcified mass.

under nitrous oxide-oxygen-ether anesthesia through an inverted J incision made from the level of the deltoid tubercle of the humerus and continued high over the central anterior aspect of the deltoid muscle medially to the acromion region and lateromedially downward to the fifth right interspace where it terminated 4 cm. from the midclavicular line. The skin flaps were dissected upward, medially and laterally to expose the anterolateral aspect of the pectoralis major and the lateral border of the latissimus dorsi muscles. The pectoralis major muscle was separated along the course of its fibers, between the clavicular and sternal portions, to the bicipital groove at which point the sternal segment was divided 2 cm. medial to its tendonous insertion. The sternal part of the muscle was then dissected medially to expose the axilla, pectoralis minor muscle, and costocorocoid membrane. Incision of the costocorocoid membrane permitted the insertion of the right index finger mediolaterally beneath and close to the posterior surface of the minor muscle. Upward and downward motion of the finger freed the muscle from subjacent structures to its insertion on the corocoid process. The suspensory ligament (fascia) of the axilla was incised at the lateral margin of the minor muscle which latter was then divided between hemostats

3 cm. from its insertion. The inferior section of the pectoralis minor muscle was retracted downward and medially to expose the subclavian and axillary regions. The tumor was then clearly outlined, beneath a layer of fibroareolar tissue, fully occupying the subscapular space and projecting into the axillary and supraclavicular fossae. A tributary of the dorsal scapular vein appeared anteriorly, having penetrated the center of the tumor, and passed obliquely upward into the lateral thoracic vein. It lay between the capsule of the tumor and the more superficial areolar tissue. After severing this venous tributary between hemostats and ligating its terminal ends, the tumor was exposed by scissors dissection. Cleavage was obtained with difficulty and freeing of the mass in the subscapular depths by scissors and digital maneuvering was time consuming and toilsome. However, bleeding was minimal and of a capillary nature. After the tumor was extricated, the divided muscles were united to their respective tendonous insertions with interrupted, mattress, cotton sutures. Three gutta-percha drains were passed from the subclavian, subscapular, and axillary fossae through a stab wound in the skin and subcutaneous panniculus. The stab wound lay in the posterior axillary line opposite the fourth right interspace. The skin was closed with vertical, mattress, cotton sutures.

Grossly the mass was inclosed in a neomembrane. The specimen consisted of a heart-shaped tumor that weighed 390 Gm. It measured  $13 \times 11.5 \times 5.5$  cm. Adherent to its surface were numerous fatty tabs and some fibrous tissue. Several areas of hemorrhage were visible within the capsule wall. The consistency was hard and rock-like. On cross section the mass presented a mottled appearance, apparently consisting of rather dense cancellous bone with areas of intermingled fatty and red marrow. Considerable blood-tinged fluid escaped from the cut surface.

Microscopic section showed an encapsulated bony mass. The capsule was made up of pale pink-staining acellular connective tissue mingled with a small amount of fat. The surface of the bone was fairly smooth, but did not show a well defined periosteum. The cancellous bone in the central portion showed well formed, typical, bony trabeculae. No unusual amount of bone formation or destruction was evident. Between the bony trabeculae a

typical marrow structure was evident. In some areas this consisted solely of fat while at other points the fat was interspersed with large areas of myeloid cells. These cells included megakaryocytes, granulocytes in all stages, and cells of the erythroblastic series. Considerable numbers of red blood cells were also seen at some points. Diagnosis: Ossified hematoma.

Progress, despite primary healing of the wound and the reasonably prompt return of function of the extremity, was trammeled by an inordinate apprehension of paralysis, the result of psychologic conditioning. Repeated warnings and advice against operation by previously consulted physicians, in whom the patient had supreme confidence, covertly inhibited recovery through the expectation of an unfortunate consequence. Therefore, the hospitalization period was prolonged for the purpose of allaying fear through the medium of objective substitution and physiotherapy. The patient was discharged to duty on June 14, 1943. Function was completely returned, although there was a tendency to hold the distal phalanges of all digits in partial flexion. The neurological findings twenty-six days after operation were essentially unchanged, but the numbness and tingling were relieved. X-ray examination on August 3, 1943, four and one-half months after operation, showed no evidence of recurrence.

#### COMMENT

In the case reported an ossified hematoma of long standing was successfully removed. Its location, clinical manifestations, and histologic characteristics were unique.

The deformity of the ribs and the displacement of the scapula were curious findings suggesting a peripheral deposition of calcium which, as the mass increased in volume, compressed the relatively less fixed adjacent structures. Early involvement of the medial cord of the brachial plexus was assumed from the history of numbness which persisted from the time of injury. Pain and tingling were of more recent origin and led to the conjecture that a slowly progressive peripheral extension had further involved the nerve

trunk and was responsible for mild, but increasing, vascular symptoms. A scalenus anticus syndrome was simulated.

The histologic structure resembled bone marrow, the apparent hematopoietic function of which was not satisfactorily explained. It was not considered of compensatory nature because anemia did not follow operation.

Adequate exposure and facility of approach, without the production of a disabling scar, was accomplished by a technic

similar to that used for clearing the axilla in the process of radical mastectomy. The simplicity with which the subclavian, axillary, and subscapular regions can be exposed by the technic described warrants its recommendation as an approach to surgical lesions in those locations.

Immediate relief from the neurologic manifestations was not expected in view of the long history and the probability of nerve degeneration. Eventually, however, complete recovery is anticipated.



THE major complication in these cases (of regional ulcerative colitis) is colonic perforation. This may necessitate temporary colostomy proximal to the lesion with subsequent resection, anastomosis if possible, and ultimate closure of the colonic stoma. It is well to allow several months to intervene between the several stages of this procedure.

# ORCHITIS AS A COMPLICATION OF BRUCELLOSIS (UNDULANT FEVER)

EARL SANBORN, M.D.

Resident in Urology, Massachusetts Memorial Hospitals; formerly Resident Physician, Illini Community Hospital, Pittsfield, Illinois

BOSTON, MASSACHUSETTS

**N**OT infrequently the urologist, and occasionally the general surgeon, is confronted with a patient presenting a swollen testicle with associated pain, tenderness and a temperature. These signs and symptoms are essentially those of an acute orchitis but the etiological agent must be determined if an accurate diagnosis is to be made and the proper treatment initiated. Experience with two patients having orchitis, in a series of seventeen cases of brucellosis, was such that their case reports might be of interest and aid to others who might have patients presenting similar symptoms.

## CASE REPORTS

**CASE 1.** Mr. W. G., a thirty-six-year old, married, white farmer was admitted to the hospital on July 14, 1942. For at least the previous ten days the patient had had a temperature which rose at times to 104° F. The right testicle had been found swollen one morning at the onset of the fever and the swelling had increased slightly subsequently. Diarrhea had been present for two days; the bowel movements had numbered ten to fourteen daily. Nausea and vomiting had been present for the same period. Several times at home the patient had had severe shaking chills that lasted several minutes. Following these he had perspired profusely and his feet had become cold. Left frontal headaches had been present and a "stomach ache," which must have been lower abdominal cramps, was a complaint. Irritability, restlessness, malaise, and anorexia had been present according to the patient.

Inventory by systems was essentially negative except for frequent "nose bleeds" as a boy, occasional pain and bleeding with bowel movements, pruritus ani, and some loss of

weight with the present illness. His past history included scarlet fever, smallpox, chickenpox, peritonsillar abscesses, gonorrhea, "sinusitis," and a fracture of the lower third of the right tibia.

Physical examination revealed a large, well developed, well nourished white male who was obviously ill. The blood pressure was 114 systolic and 74 diastolic; temperature, 99° F.; pulse, 88; respirations, 22. Positive findings included several carious teeth, atrophic tonsils, enlarged spleen, and an old scar on the lower third of the right leg. The right testicle was swollen (5 by 4 by 4 cm.) and tender to palpation. There was questionable swelling of the globus major of the epididymis.

The first hospital day was characterized by diarrhea and an oral temperature of 104° F. in the evening. Examination of the blood showed a white cell count of 9,500, a normal differential count, and a red cell count of 4,800,000 with 85 per cent hemoglobin. Treatment initiated by the attending physician included bed rest, liquid to soft diet, scrotal support, cold packs to the right testicle, and 3,000 cc. of fluids intravenously, containing 10 Gm. of sodium sulfathiazole (sulfathiazole had been given orally at home when patient had refused hospitalization).

On the morning of July 15th, a rectal examination was done under sodium pentothal because the patient complained of periodic rectal pain and it was thought a peri-anal abscess should be drained. No abscess was found. KaO Magma was prescribed for the diarrhea which continued; 2,000 cc. of intravenous fluids were given because of the profuse perspiration and diarrhea. Agglutination tests, which had been suggested by the writer, for paratyphoid fever A and B and typhoid fever were negative but that for brucellosis was strongly positive. The blood culture was reported as negative for twenty-four hours. Routine urinalysis, stained smear of urine

sediment, Kahn serology, and an x-ray film of chest were normal. Stool examination showed occult blood strongly positive, a few "pus cells," and no parasites. The sulfathiazole blood level was 8.62 mg. per cent. (Two days later it was 7.50 mg. per cent.) Sulfadiazine by mouth was ordered after the positive agglutination test for brucellosis was reported.

On the third day the temperature dropped from a plateau of 102°F. to 99°F. in the morning, but in the evening it was 103.4°F. A light diet was initiated during the day and oral intake of fluids was adequate for the diarrhea had ceased. Perspiration continued.

The remaining days in the hospital were characterized by normal temperature, absence of profuse perspiration and diarrhea, reduction of chemotherapy dosage, discontinuance of scrotal support and Kao Magma, and getting the patient up in a wheel chair the day before his discharge on July 20th, the sixth hospital day. The swelling and tenderness in the right testicle were both decreased.

An attempt was made to contact the patient six months later for a check-up on his subsequent course, but this was unsuccessful. The source of infection in this case was probably via unpasteurized milk from the family milk cow. The farmer's herd was to be tested for brucellosis by a veterinarian subsequent to hospitalization.

CASE II. Mr. L. G., a thirty-two-year old, married, white automobile mechanic entered the hospital on December 2, 1942. A swelling had appeared in the right half of the scrotum five days previously. This swelling had increased as well as the associated pain. The patient had thought at first that he had a "rupture" from lifting something too heavy. A physician had been seen who told the patient that he had a "ruptured vein." On November 30th, the patient had had a temperature of 103°F. As a result sulfathiazole therapy had been initiated. The temperature on December 1st had been 102.8°F.

Inventory by symptoms revealed approximately three pounds of weight loss in the past year, recent night sweats, "light-headed feeling at times," frequent attacks of coryza, "bad tonsils," shortness of breath upon slight exertion, heartburn over precordium, occasional palpitation, "skipped heart beats," and lumbar backache since working in the garage.

Past history included measles, mumps,

pertussis, chickenpox, scarlet fever, "heart trouble" when eight or nine years of age, and no history of venereal disease. He had been married thirteen years and his wife and two sons had been in good health.

Physical examination demonstrated an asthenic, well developed, well nourished white male who was not acutely ill. The blood pressure was 102 systolic and 52 diastolic. Temperature was 100.6°F.; pulse, 84; respirations, 26. Positive findings included hypertrophied tonsils; slightly coated tongue; and a heart, which was enlarged to the left, presented extrasystoles, and a possible soft systolic murmur. The right testicle was enlarged to the size of a small lemon (4.5 by 3.5 by 3.5 cm.) and was very tender to palpation. The epididymis did not seem to be involved.

Upon admission sulfathiazole was continued by the attending physician. The scrotum was supported and an ice bag applied to the right scrotum. Urinalysis and Kahn test were negative. Blood examinations demonstrated a white cell count of 9,000, a normal differential count, and a red cell count of 4,500,000 with 80 per cent hemoglobin. Memory of Case I, a brief clinical history, and the physical findings prompted the requisition of a brucellosis agglutination test by the writer. This proved to be strongly positive (1:320 dilution). Chemotherapy was then abandoned and specific vaccine therapy in graduated doses initiated.

The pain in the right scrotum, which radiated superiorly to the right inguinal region, and possibly to the lower part of the back, was absent after three days. Soreness of the right testicle continued as did the swelling. There was profuse perspiration during the night and the patient complained of being weak in the mornings until December 7th. The temperature remained normal after December 4th and the patient was discharged on December 8th (sixth hospital day) considerably improved.

This patient was seen on January 20, 1943. There was no atrophy of the testicle. The only complaints were malaise, rather frequent headaches, and weakness upon exertion. He was doing light work and had not resumed his regular work. The source of the infection was determined after the patient was discharged. Unpasteurized milk had been purchased up to six weeks previous to hospitalization. Although the patient did not drink milk often, he had consumed some. The cow which had been furnishing the milk was tested for

brucellosis and found to have a "positive reaction." (Blood of the cow was sent to the State laboratory by a veterinarian and the agglutination test for brucellosis was found to be positive.)

#### INCIDENCE

Orchitis occurs as a complication in 4 to 10 per cent of all the cases of brucellosis according to various authors. Meakins<sup>9</sup> states that the system which bears the brunt of the disseminated lesions of brucellosis is the genitourinary tract with orchitis occurring in 10 per cent of the cases. Several cases have been described in the foreign literature but only two have been discussed at length in the American literature. Isaac<sup>8</sup> realized the significance of considering brucellosis in the diagnosis of orchitis when he described a case before a meeting of the urologists in 1937. Buckley,<sup>2</sup> another urologist, in presenting a case called attention to the increasing frequency of brucellosis and the likelihood of the presence of more associated genitourinary complications. Simpson<sup>14</sup> reported sixteen cases of painful swelling of the testes in his series of brucellosis cases around Dayton, Ohio. Four cases were reported by Hardy<sup>5</sup> in his series of 125 patients having brucellosis in Iowa.

#### ETIOLOGY

According to Hinman<sup>6</sup> there are a number of conditions responsible for an acute or chronic orchitis. The acute type may be an ascending type from the posterior urethra via the vas deferens and epididymis resulting in an epididymo-orchitis. Rolnick<sup>11</sup> believes this route of infection is most unlikely. Wesson<sup>15</sup> states that traumatic orchitis and that from strain have been shown to be misnomers. Such conditions result from trauma with subsequent ascending or metastatic infections.

Acute metastatic orchitis is usually a complication of infectious diseases. It has been reported in cases of mumps, diphtheria, scarlet fever, small pox, in-

fluenza, typhus fever, dengue, glanders, malaria, typhoid fever, and pneumonia. Gout and filariasis have also been reported. In addition, foci of infection may be a source. Such lesions include tonsillitis, furunculosis, osteomyelitis, acute articular rheumatism, dental abscesses, sinusitis, cholecystitis, and appendicitis. The organisms involved are pyogenic in character, usually *Bacillus coli* and *staphylococci*. The chronic type of orchitis is usually due to syphilis.

#### PATHOLOGY

Any organism in the blood stream may enter the testes and, if there is a lowered resistance locally, or an abundance of infective organisms, a foothold may be gained and an orchitis result. However, organisms that invade the general circulation are rapidly filtered out and destroyed so that as far as the testicle is concerned blood borne infections are relatively rare.

According to Boyd,<sup>1</sup> unilateral orchitis is more common than bilateral inflammation of the glands. The testicle is only moderately enlarged owing to the firm non-elastic tunica albuginea by which the organ is surrounded. It is for this reason the patient has excruciating pain. In metastatic orchitis the epididymis is rarely involved. There is no associated hydrocele with orchitis as with epididymitis because of the intact tunica albuginea.

Sharp<sup>13</sup> in his general review of the pathology of undulant fever comments on the fact that the literature is not yet adequate for a clear conception of the morbid anatomy of brucellosis. The chief contributing factor is the limitation of post-mortem material due to the low mortality rate. He cites the microscopic findings of a case of brucellosis reported by Rothenberg.<sup>12</sup> This seems to be the only pathological description in the English literature of orchitis complicating brucellosis and in this case the patient evidently did not have an orchitis as a clinical entity. It may be said the patient had been married thirty-two years without any offspring.

"The testes revealed complete aspermato genesis with evidence of active interstitial orchitis and scattered areas of fibroid atrophy. Vacuolar degeneration of the epithelium was noted." Pathological descriptions are not to be found because the orchitis complicating brucellosis usually is a self-limited disease.

Hinman<sup>6</sup> states that, in general, acute inflammatory processes manifest themselves between, not within, the canaliculi of the testicle. Multiple foci of infection are seen. The tubules then degenerate and become filled with inflammatory exudate. Local areas of necrosis occur and become conglomerate. The process may go on to suppuration.

#### SIGNS AND SYMPTOMS

Severe testicular pain is usually the first symptom of orchitis for the reason given by Boyd.<sup>1</sup> Associated is tenderness and swelling of the organ, elevation of temperature, and, not uncommonly, nausea and vomiting. The scrotum usually becomes reddened. There is more prostration than in most cases of acute epididymitis. The pain may be referred to the back, the perineum, or upward along the spermatic cord according to Pelouze.<sup>10</sup> The globus major of the epididymis may become involved.

All of these signs and symptoms were seen in the two cases described and for this reason a patient may consult a urologist or a general surgeon although he has brucellosis. It is significant to note that the patient with brucellosis does not look as ill as his chart indicates. In other words, there is an appearance of well being inconsistent with the high fluctuations of temperature.

#### DIAGNOSIS

The combination of clinical history, physical examination, and laboratory studies in making a diagnosis is well illustrated here. A good history will elicit the systemic symptoms of brucellosis in addition to the course of local signs and symptoms.

Foshay,<sup>4</sup> who has been keenly interested in brucellosis, concludes that there are no laboratory tests for this disease which do not have serious limitations. He adds that there are no acceptable clinical criteria for the diagnosis of brucellosis, nor for its exclusion and, therefore, it is impossible to reach a clear cut decision concerning the validity of the tests, alone or in combination. Yet few diseases depend more on the laboratory for a diagnosis than brucellosis. Only in communities where the disease is known to exist can a diagnosis be made without a laboratory test and then only hazardously.

The specific agglutination test of the blood is of greatest practical value in the diagnosis. In the two cases presented the antigen of *Brucella abortus* was used. The blood serum from cases of brucellosis does not always agglutinate the antigen and that from patients without the infection may give positive agglutination tests in low titers. There have been patients with brucellosis with negative serum agglutination tests or positive only in low titers. However, patients with the disease usually give positive reactions in high dilutions (1 to 80 or better). Foshay<sup>4</sup> states that next to recovery of the *Brucella* organisms by culture, a high serum agglutination titer is the most reliable test. The test usually becomes positive by the second week of the illness. In men and inoculated animals there is cross-agglutination between the *Brucella* and *Bacillus tularensis* of tularemia. However, the titer is usually higher for the specific disease.

#### TREATMENT

The therapy of orchitis is conservative in character; "watchful waiting" in the words of Pelouze,<sup>10</sup> for the infection usually subsides. Scrotal support gives considerable comfort. Local hot or cold applications and analgesics systemically are the basis of the treatment. Christopher<sup>3</sup> states that incision will rarely be necessary; the therapy should be directed toward the causal infection. Surgical in-

tervention is indicated if fluctuation and suppuration or necrosis develop. Drainage is then initiated for small areas of suppuration and orchidectomy if the area is large.

As for brucellosis, prophylactic treatment consists of pasteurization of the milk for human consumption. In addition, individuals in contact with livestock, as cattle and hogs, or fresh meat should protect themselves adequately. Vaccination of young animals and removal of those infected is said to prevent the dissemination of the disease. Prophylactic immunization has been reported. Specific therapy has not proved successful. Anti-serums, vaccines, brucellin, non-specific protein therapy, chemotherapy, and artificial fever have all been used with inconclusive results in patients with brucellosis. Sulfa-diazine was used in the first case herein reported. In the second case an oxidized *Brucella abortus* vaccine (Foshay) was used. Symptomatic treatment utilizing vitamins, sedatives, laxatives, adequate fluid intake and nourishment is, of course, indicated.

#### PROGNOSIS

Orchitis is usually transitory and there are no serious after-effects when one of the *Brucella* is the causative organism. Occasionally, a suppurative orchitis or an epididymitis develops. Huddleson<sup>1</sup> states that there have not been any cases of sterility following the orchitis complicating brucellosis.

Although the mortality rate of brucellosis is about 2 per cent, according to vital statistics, the chronic invalidism of a patient with the disease is of some concern. Fatal cases result from acute overwhelming infections or the subsequent localized lesion in the meninges, brain, lungs, or heart valves.

#### COMMENTS

With the significant increase in the number of reported cases of brucellosis undoubtedly more of the complications

of the disease will be in evidence. In Illinois, three times as many cases were reported in 1941 as in 1932. Only five cases had been reported from the county in the ten years preceding the six months in which the seventeen cases were observed. In the United States, the reported cases of brucellosis have steadily increased from twenty-four in 1925 to 3,427 in 1941.<sup>7</sup>

It appears that the genital tract attracts as many of the disseminated lesions of brucellosis in humans as it does in susceptible animals. As the localized genito-urinary lesion, orchitis may be the reason for the patient consulting the urologist or general surgeon. Such men should be ready to investigate obscure genital lesions for *Brucella* infections.

#### SUMMARY

Two cases of orchitis complicating brucellosis with additional remarks are presented.

#### REFERENCES

1. BOYD, W. *Surgical Pathology*. Philadelphia, 1939. W. B. Saunders Company.
2. BUCKLEY, T. I. *Brucellosis of the male genitalia*. *California & West. Med.*, 48: 175, 1938.
3. CHRISTOPHER, F. *Minor Surgery*. Philadelphia, 1940. W. B. Saunders Company.
4. FOSHAY, L. *Laboratory diagnosis of undulant fever*. *Am. J. of Clin. Path.*, 10: 176, 1940.
5. HARDY, A. V. *Undulant fever. A clinical analysis of one-hundred and twenty-five cases*. *J. A. M. A.*, 92: 853, 1929.
6. HINMAN, F. *The Principles and Practice of Urology*. Philadelphia, 1937. W. B. Saunders Company.
7. HUDDLESON, I. F. *Brucellosis in Man and Animals*. New York, 1943. The Commonwealth Fund.
8. ISAAC, A. G. *Orchitis and epididymitis due to undulant fever*. *J. Urol.*, 40: 201, 1938.
9. MEAKINS, J. C. *The Practice of Medicine*. St. Louis, 1938. C. V. Mosby Company.
10. PELOUZE, P. S. *Office Urology*. Philadelphia, 1941. W. B. Saunders Company.
11. ROLNICK, H. C. *Pathology of Epididymis*. *Surg., Gynec. & Obst.*, 47: 806, 1928.
12. ROTHEMBERG, R. C. *Undulant fever: a fatal case*. *Ann. Int. Med.*, 6: 1275, 1933.
13. SHARP, W. B. *Pathology of undulant fever*. *Arch. Path.*, 18: 72, 1934.
14. SIMPSON, W. M. *Undulant fever (brucellosis): a clinico-pathologic study of ninety cases occurring in and about Dayton, Ohio*. *Ann. Int. Med.*, 4: 238, 1930.
15. WESSON, M. B. *Traumatic orchitis; misnomer*. *J. A. M. A.*, 91: 1857, 1928.

# PENICILLIN

## CASE REPORT OF A PATIENT WHO RECOVERED FROM PUERPERAL SEPSIS HEMOLYTIC STREPTOCOCCUS SEPTICEMIA

ROBERT McN. MITCHELL, M.D. AND SANFORD KAMINESTER, M.D.

Resident in Obstetrics and Gynecology,  
Greenpoint Hospital

Associate Visiting Obstetrician and Gynecologist,  
Greenpoint Hospital

BROOKLYN, NEW YORK

**A** report of a patient recovering from a puerperal sepsis complicated by a hemolytic streptococcus (long chain variety) septicemia which failed to respond

teen hours. Three hours later a normal full term living female infant was delivered from the right occipitoanterior position. A complicated third stage of labor was anticipated since

TABLE I

Date	Day Post-partum	Red Blood Cells, Millions	White Blood Cells	Hemoglobin Gm.	Blood Culture	Sulfa-thiazole (Blood) Mg. Per Cent	Urine	Transfusion	Sulfathiazole Oral	Sulfathiazole I.V.
4-10-43	1						neg.	350 cc.		
4-11-43	2	2.2	7,600	9.5	65				start	
4-12-43	3								stop	
4-13-43	4									
4-14-43	5									
4-15-43	6									
4-16-43	7	2.28	10,800	7.5	51					
4-17-43	8	1.7	6,200	7.5	51	taken			start	start
4-18-43	9	1.2	5,620	7.0	48			250 cc.	stop	stop
4-19-43	10						13.2	neg.		
4-20-43	11						3.8	200 cc.		
4-21-43	12									
4-22-43	13	2.1	5,500	8.0	54			200 cc.		
4-23-43	14									
4-24-43	15	2.57	5,200	9.0	61					
4-25-43	16									
4-26-43	17					no growth				
4-27-43	18									
4-28-43	19						patient discharged today			

to the sulfa drugs but did respond to penicillin is indeed a therapeutic triumph which cannot be ignored and merits a place in the literature.

### CASE REPORT

The patient, a thirty-five year old white female, at term, gravida vii, para vi, entered Greenpoint Hospital on the evening of April 9, 1943, in active labor. At the time of admission the duration of parturition had extended four-

a history of two previous retained placentas, one fourteen years ago and one eight years ago, had been obtained. A bleeding third stage developed. Posterior pituitary extract (1 cc.) was given intramuscularly but proved ineffectual. Manual removal of the adherent placenta was completed under open drop ether anesthesia. Following this procedure the bleeding was controlled, not, however, until approximately a liter of blood had been lost. Replacement therapy consisted of a liter of 5 per cent glucose

in normal saline followed several hours later by a citrated blood transfusion, the latter finishing without noticeable immediate reac-

tion. The hospital stay lasted nineteen days.

The patient was readmitted two days later

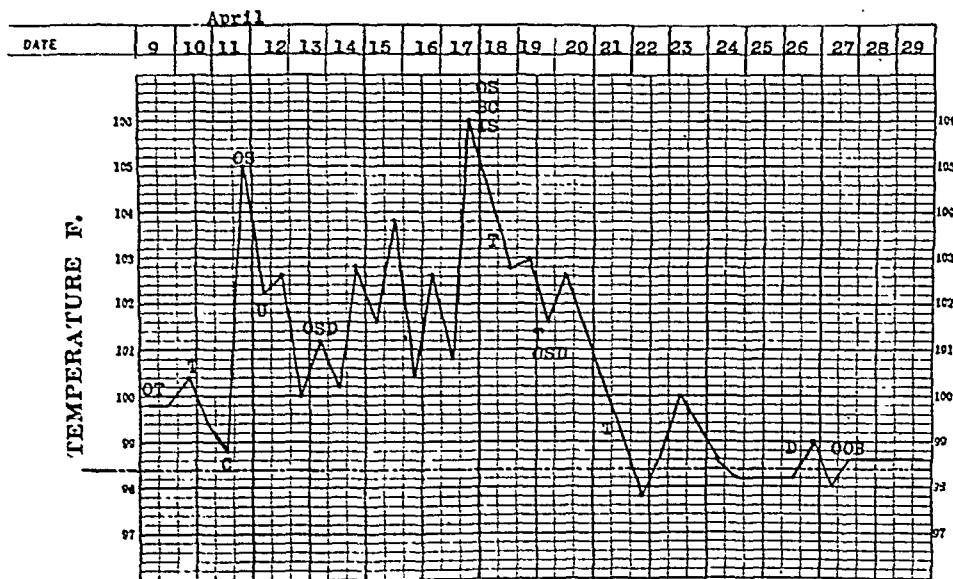


FIG. 1. OT, oral temperature; T, transfusion of citrated whole blood; OS, oral sulfathiazole; IS, intravenous sulfathiazole; OSD, oral sulfathiazole discontinued; U, urticaria; OOB, out of bed; BC, blood culture; C, chill.

tion. The blood pressure was recorded at 138/74, the pulse was slow and of good quality.

On April 11th, the second postpartum day, the patient had a severe chill with rise in temperature to 104°F. (oral). Sulfathiazole was started orally at this time. On the following day, a generalized urticaria developed to confuse the picture. The question of whether the reaction was from ergotrate, transfusion or sulfa drug remained undetermined. The consulting dermatologist pronounced the skin reaction a dermatitis medicamentosa and advised withholding therapy except supportive and routine postpartum care. Deprived of the best therapeutic measures the postpartum course became tempestuous until, on the eighth postnatal day, when the temperature rose to 106°F. (oral), it was decided to brave the consequences and once again institute the sulfa drug. The urticaria by this time had greatly diminished, hence, 5 Gm. of sodium sulfadiazine were given intravenously and sulfathiazole was started orally. Marked improvement in the patient's condition followed during the course of the next six days, the temperature falling to normal. A thrombophlebitis was noted on the fourteenth postpartum day in the left leg involving both the calf and thigh but appeared to be definitely subsiding. Discharge was

complaining of chills, fever, lower abdominal and pelvic pain. The impression was that of a severe pelvic thrombophlebitis. The patient's course was notably stormy and response to therapy was nil. The organisms apparently had become sulfonamide fast. Oral and intravenous sulfa drugs were administered until the white blood count reached such a low level that it became inadvisable to continue. Frequent small transfusions were given and convalescent serum (scarlet fever) was injected intravenously, but all to no advantage. The patient's condition became steadily worse until, in the opinion of those rendering therapy, little if any hope existed for recovery. The patient seemed moribund and terminus was expected momentarily. Five positive blood cultures were reported on May 13, May 18, May 24, May 29 and June 2, 1943. The cultures showed a long chain variety of *Streptococcus hemolyticus*. A large tender, readily palpable spleen presented itself. Petechiae in skin and mucous membranes were absent. No evidence of endocarditis was recognized. The lungs remained clear for the most part except for hypostatic râles in each base. The pulse was very rapid (132) and bounding; respirations (50) shallow and labored, the mental status befogged and speech delirious. Carphologia was present.

Through the advice of Dr. H. J. Green, the administration of penicillin was begun; 38,800, fifth day 35,200, sixth day 35,200, seventh day 26,400. The first 74,200 units of

TABLE II

Date	Day Post-partum	Red Blood Count, Million	White Blood Count	Hemo-globin, Gm.	Differential			Blood Urea, Mg. Per Cent	Sed. Time 18 Mm.	Blood Culture	Trans-fusions
					Poly, Per Cent	Lymph, Per Cent	Mono, Per Cent				
4-30-43	21										
5- 1-43	22	2.31	29,300	8.5	86	14	...	...	20 min.		
5- 2-43	23	...	...	...	...	...	...	...	...		
5- 3-43	24	...	...	...	...	...	...	...	...		
5- 4-43	25	...	...	...	...	...	...	...	...		
5- 5-43	26	...	...	...	...	...	...	...	...		
5- 6-43	27	...	...	...	...	...	...	...	...		
5- 7-43	28	...	...	...	...	...	...	...	...		
5- 8-43	29	...	...	...	...	...	...	...	...		
5- 9-43	30	...	...	...	...	...	...	...	...		
5-10-43	31	...	...	...	...	...	...	...	...		
5-11-43	32	2.57	3,700	7.5	50	50	...	...	15 min.		100 cc.
5-12-43	33	...	...	...	...	...	...	26			
5-13-43	34	...	...	...	...	...	...	...		positive	200 cc.
5-14-43	35	...	...	...	...	...	...	...			250 cc.
5-15-43	36	...	...	...	...	...	...	...			
5-16-43	37	...	...	...	...	...	...	...			
5-17-43	38	2.56	4,500	7.5	54	46	...	...			
5-18-43	39	...	...	...	...	...	...	...		positive	250 cc.
5-19-43	40	...	...	...	...	...	...	...			
5-20-43	41	...	...	...	...	...	...	...			250 cc.
5-21-43	42	2.8-	3,600	7.5	66	34	...	26			25 cc.
5-22-43	43	...	...	...	...	...	...	...			
5-23-43	44	...	...	...	...	...	...	...		positive	250 cc.
5-24-43	45	2.62	4,200	7.5	77	21	2	...			
5-25-43	46	1.89	3,800	7.5	63	37	...	...			
5-26-43	47	...	...	...	...	...	...	...			
5-27-43	48	...	...	...	...	...	...	...			
5-28-43	49	...	...	...	...	...	...	...			400 cc.
5-29-43	50	...	...	...	...	...	...	...		positive	
5-30-43	51	...	...	...	...	...	...	...			
5-31-43	52	...	...	...	...	...	...	...			
6- 1-43	53	...	...	...	...	...	...	...			
6- 2-43	54	3.28	2,800	8.5	...	...	...	...		positive	500 cc.
6- 3-43	55	...	...	...	...	...	...	...			
6- 4-43	56	...	...	...	...	...	...	...			
6- 5-43	57	4.14	3,550	8.0	77	23	...	...			500 cc.
6- 6-43	58	...	...	...	...	...	...	...			
6- 7-43	59	2.60	4,650	8.5	70	28	2	...		neg. 48 hr.	550 cc.
6- 8-43	60	...	...	...	...	...	...	...			
6- 9-43	61	3.23	3,700	11.0	...	...	...	...		neg. 48 hr.	500 cc.
6-10-43	62	...	...	...	...	...	...	...			
6-11-43	63	...	...	...	...	...	...	...			
6-12-43	64	3.82	5,700	10.5	68	32	...	over 1 hr.	neg. 48 hr.		
6-13-43	65	...	...	...	...	...	...		neg. da.		
6-14-43	66	...	...	...	...	...	...				
6-15-43	67	...	...	...	...	...	...				
6-16-43	68	...	...	...	...	...	...				
6-17-43	69	3.20	5,000	9.5	54	46	...			neg. da.	
6-18-43	70	...	...	...	...	...	...				
6-19-43	71	...	...	...	...	...	...				
6-20-43	72	...	...	...	...	...	...				
6-21-43	73	...	...	...	...	...	...				
6-22-43	74	...	...	...	...	...	...				
6-23-43	75	...	...	...	...	...	...				
6-24-43	76	4.32	5,600	12.5	62	36	2	1 hr.	neg. 4 da.		

42,400 Oxford units were given during the first twenty-four hours. This dosage was repeated on the second day. On the third day 40,600 Oxford units were injected, fourth day

penicillin were conveyed by the medium of 5 per cent glucose in alternate solutions of distilled water and normal saline. The remainder was administered either intramuscularly or sub-

cutaneously in gradually decreasing amounts, dissolved in 2 cc. of normal saline. A total of the patient's condition was decidedly improved. The fever began to subside, the mental

TABLE II (Continued)

358,500 Oxford units of penicillin were given over the course of eleven days.

Within twenty-four hours following the inauguration of this therapeutic bombshell

status brightened, urinary and fecal incontinence became controlled, and pulse and respiration improved. The temperature was normal in forty-eight hours. Together with these

changes, too good to be true, hope for her recovery revived. Each blood culture drawn thirty-six hours, eighty-four hours, 132 hours and 180 hours after onset of treatment with

she was allowed up in a wheel chair and on June 24th she was up and about anxiously awaiting discharge from the hospital which was granted on June 26th. The patient had been at

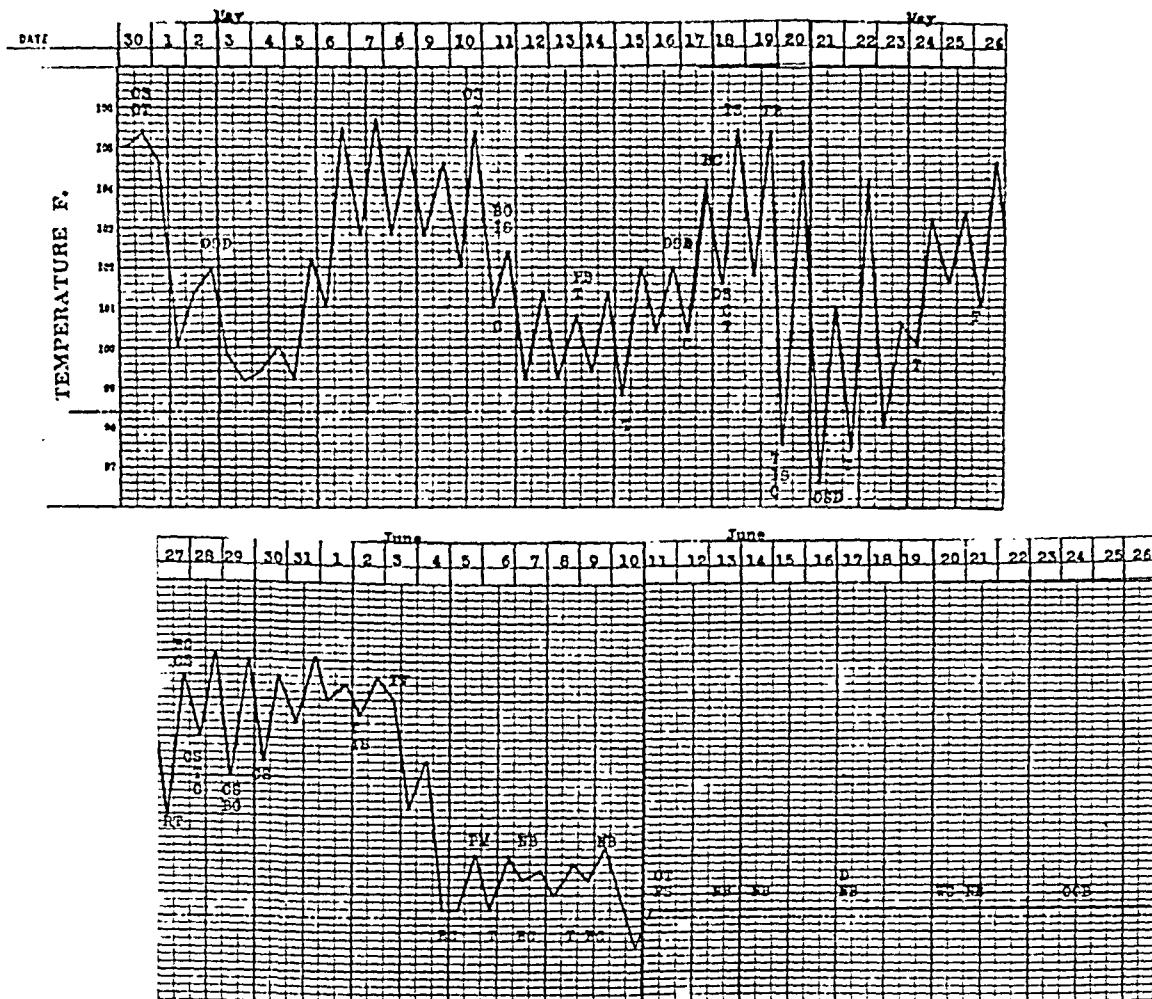


FIG. 2. T, transfusion of citrated whole blood; os, oral sulfathiazole or sulfadiazine; osd, oral sulfa drug discontinued; RT, rectal temperature; OT, oral temperature; C, chill; NC, blood culture taken; IS, intravenous sulfadiazine; PB, positive blood culture; NN, negative blood culture; CS, convalescent serum; PV, penicillin intravenously; PM, penicillin intramuscularly; WC, patient sitting in wheelchair; OOB, out of bed.

penicillin was reported negative subsequent to forty-eight hours' incubation and also following a seven-day period of incubation.

The patient progressed steadily toward recovery. The temperature curve remained normal for the remainder of her hospital stay. On June 17th, she was permitted to dangle her legs over the edge of the bed; three days later

the hospital fifty-seven days. Graphic representation of fever curve, therapy and laboratory findings are shown in Figures 1 and 2.

We wish to express our appreciation to Dr. T. S. Welton, Director of Obstetrics and Gynecology at Greenpoint Hospital, Brooklyn, N. Y. for granting permission to publish this case.



# RUPTURE OF THE RECTOSIGMOID BY COMPRESSED AIR\*

## CASE REPORT

S. A. SWENSON, JR., M.D.

AND

HENRY N. HARKINS, M.D.

Assistant Resident Surgeon, Henry Ford Hospital

Associate Surgeon, Henry Ford Hospital

DETROIT, MICHIGAN

ALTHOUGH traumatic perforations of the rectum and the rectosigmoid are relatively well known, reports of cases of rupture by compressed air are limited in number. On the other hand, impalement on some object is a frequent cause of traumatic rectal perforation, and numerous cases have been reported.<sup>2,5,6,7</sup>

The condition of rupture by compressed air, which is a now well recognized industrial accident, was first reported by Stone in 1904.<sup>9</sup> Andrews, in 1911,<sup>1</sup> first brought critical attention to its pathogenesis, and pointed out that the jet of compressed air need only be pointed in the direction of the anus, the buttocks forming a funnel-like structure, directing the stream into the anus itself. In most reported cases the jet of air has passed through the patient's clothing which offers no protection. Burt,<sup>4</sup> in 1931, in experimental work showed that relatively small amounts of pressure were sufficient to cause perforation of the intestinal tract with variations according to the distance below the pylorus.

Brown and Dwinelle (1942)<sup>3</sup> recently reviewed the literature, finding sixty cases of complete perforation and nine cases of incomplete perforation caused by compressed air. These authors added two cases of complete perforation and one case of incomplete perforation, bringing the total to sixty-two and ten, respectively. In our review of the literature, we found one more case of complete perforation reported by Santy and Marion,<sup>8</sup> another reported by Ide (1942) and operated upon by Olson, and add one case of our own, bringing the total to sixty-five of the complete type. The longitudinal

lacerations shown in an illustration in Ide's report are identical to those occurring in our own case. In both instances, incomplete lacerations involved only the outer layers of the large bowel.

Several factors in this case are of sufficient interest to warrant its report. First, the operation is an emergency procedure, and, due to variety in location of perforations, the method of repair is largely dependent upon the ingenuity of the operator. Preoperative preparation should be as extensive as possible even though time is an essential factor in morbidity and mortality. Sulfanilamide placed in the abdominal cavity is, by now, a well recognized adjunct, and should be used in any case of this type in which there has been contamination of the peritoneal cavity by intestinal contents.

## CASE REPORT

B. A., an obese, white Italian male, aged forty-three, a laborer, was brought to the Henry Ford Hospital from an industrial plant on August 18, 1942. An hour before admission, while he was bending over a fellow worker turned a compressed air hose at the patient's buttocks and released a sharp blast of air. The patient fell to the floor and immediately felt sharp abdominal pain, and noted that he was "blown up like a balloon." The patient was taken to the First Aid room at the plant and was immediately transferred to the Henry Ford Hospital.

On admission he was seen to be well developed and well nourished, but in very evident and acute distress. History was obtained as above. Physical examination was essentially negative except for marked abdominal distention, rigidity and tenderness. The abdomen was highly tympanitic to percussion. Blood

\* From the Division of General Surgery, Henry Ford Hospital, Detroit.

pressure was 165/115, pulse 88 per minute, and temperature 99°F. No external injuries were evident around the anus or peri-anal tissues. The blood Kolmer, Kahn, and Eagle tests were negative; the white blood count was 7,000 with 46 per cent polymorpho-nuclear neutrophiles and 54 per cent small lymphocytes.

A diagnosis of traumatic perforation of the rectosigmoid was made and immediate operation was decided upon. Continuous gastric suction was begun and the operation was done under spinal anesthesia, using 18 cc. of nupercaine. A midline incision was made from the pubis to half-way between the umbilicus and the xiphoid, exposing the peritoneum, which was seen to be bluish and stretched. When the peritoneum was opened, at least 2 liters (possibly 3 to 4 liters) of air gushed out under sufficient pressure to cause a whistling sound and resulting in a marked collapse of the distention. The bowel was explored from one end of the rectum to, and including the stomach, and four lacerations in the rectum and rectosigmoid were found. The remainder of the bowel showed considerable edema but no marked distention. There was some fibrin on all of the peritoneal surfaces associated with a small amount of free fluid but no definite evidence of fecal matter or peritonitis was found. Two complete longitudinal through-and-through lacerations of the rectosigmoid were sutured, the first being a linear one, was sutured longitudinally, while the second being an actual defect in the tissue, was sutured transversely. Both of these were about an inch long. Deep down near the rectum itself, were two one inch long longitudinal lacerations of the serosa alone; the mucosa pouched out but was not perforated. These were both sutured longitudinally in the direction of the tear as a precautionary measure. Silk was used as suture material throughout the operation. Six Gm. of sulfanilamide powder was inserted into the peritoneal cavity. The transverse colon was mobilized and brought through the omentum and out through the wound just above the umbilicus. The wound was closed without damage, using two layers of silk, heavy, for the fascia and peritoneum, and fine for the anterior layer after four heavy silver wire through-and-through retention sutures were placed. The patient left the operating room in good condition.

When the patient reached the floor he was immediately placed in an oxygen tent and continuous gastric suction was begun. A hypodermoclysis of 1,500 cc. normal saline and 500 cc. of 0.8 per cent sulfathiazole was also immediately instituted. The postoperative temperature was 102°F., and varied between 101° and 102°F. for four days when it receded to 98.6°F. and remained normal thereafter except for very slight elevations during the next few days. Hypodermoclysis of 0.8 per cent sodium sulfathiazole, 1,500 cc. were continued daily for four days after operation, then substituted by oral sulfathiazole, 6 Gm. every day for two days, as the gastric suction was discontinued on the fourth day. Fluid balance during the four days of continuous gastric suction was maintained by parenteral glucose 5 per cent and normal saline.

The extra-abdominal transverse colon was opened on the first postoperative day, forming a double-barreled loop colostomy. This colostomy opening functioned satisfactorily following irrigation with hypertonic saline and cotton-seed oil.

The patient's subsequent convalescence was essentially uneventful except for a delay in closing the colostomy due to technical difficulties not connected with the original accident. Interestingly enough, however, about three months following the accident the patient developed a small, superficial fistula-in-ano, and redundant hemorrhoidal tissue, both of which were removed at a subsequent operation.

#### SUMMARY AND CONCLUSIONS

1. Relatively few cases of traumatic rupture of rectum and rectosigmoid from compressed air have been reported in the literature.

2. We present one case of traumatic rupture (four lacerations: two complete and two incomplete) of the rectosigmoid caused by compressed air, with comparatively uneventful recovery. This case brings the total of cases with complete rupture reported in the literature to sixty-four.

3. Incomplete ruptures usually involve the serosa, the inner layers remaining intact. In most instances involving the rectosigmoid, the rupture is longitudinal whether complete or incomplete. Except

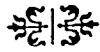
where there is an actual defect of tissue, such as occurred in one of the ruptures in our case, the tears may safely be closed in the direction of the tear, i.e., longitudinally.

4. Immediate operation is indicated when the condition is diagnosed or suspected.

5. Latent manifestations of anorectal disease might be considered as directly related to the initial trauma.

#### REFERENCES

1. ANDREWS, E. W. Pneumatic rupture of the intestine, a new type of industrial accident. *Surg., Gynec. & Obst.*, 12: 63-72, 1911.
2. BACON, H. E. and RENTHER, T. F. Wounds of anorectum and their treatment. *Surg. Clin. North America*, 17: 1809-1821, 1937.
3. BROWN, RUSSELL K. and DWINELLE, J. H. Rupture of the colon by compressed air, report of three cases. *Ann. Surg.*, 115: 13-20, 1942.
4. BURT, C. A. V. Pneumatic rupture of the intestinal canal, with experimental data showing the mechanism of perforation and the pressure required. *Arch. Surg.*, 22: 875-902, 1931.
5. CLAGETT, O. T. Rectal perforation from impalement. *Proc. Staff Meet., Mayo Clin.*, 14: 689-692, 1939.
6. JAMES, M. C. Impalement with intra-abdominal rupture, 3 cases. *Nebraska M. J.*, 25: 399-402, 1940.
7. MORLEY, J. E. Traumatic perforation of rectum. *Brit. M. J.*, 1: 16, 1939.
8. SANTY and MARION. Perforation recto-sigmoidienne par l'air comprimé. Suture. Appendicostomie complémentaire. *Lyon chir.* 35: 236-238, 1938.
9. STONE, G. W. Rupture of the bowel caused by compressed air. *Lancet*, 2: 216, 1904. Quoted by Brown and Dwinell. *Ann. Surg.*, 115: 13-20, 1942.
10. IDE, A. W. Pneumatic rupture of the bowel. *Jackson Clinic Bull.*, 4: 140-141, 1942.



MERE contact of bacilli of tuberculosis with the intestinal wall does not seem sufficient to produce intestinal tuberculosis. Factors favoring absorption of the organisms are trauma, diets deficient in vitamins, unusual virulence of the organisms and anaphylactic reactions of patients suffering from tuberculosis.

# OSTEOCHONDRITIS DISSECANS\*

## CASE REPORT

THEODORE B. STRANGE, M.D.<sup>†</sup>

ALBANY, NEW YORK

OSTEOCHONDRITIS dissecans is defined as a localized aseptic necrosis of cartilage and underlying

and when it was removed three months later the patient showed no limitation of motion and no pain in the hip. This patient



FIG. 1. The characteristic excavation of the cartilage and subchondral space of the femoral condyle is seen. The osteochondritic mass is almost completely detached.

FIG. 2. The semi-detached mass has disappeared and the cavity has become obliterated.

bone. It is usually found in adolescents and young adults and a great majority of the cases occur in the knee. A survey of the English literature for the past twenty years reveals no reported cases of this disorder in a patient as young as four and one-half years. Five cases of osteochondritis dissecans under the age of twelve years were reported, two in the hip and three in the knee. Freund<sup>1</sup> reported osteochondritis dissecans in the hip of a boy of six and one-half years. A plaster spica was applied

had had a Legg-Perthes's disease in the other hip for the previous year and a half. Gold<sup>2</sup> found this condition in the left hip of a boy eleven years. Conservative treatment led to improvement. Archer and Peterson<sup>3</sup> reported a case of osteochondritis dissecans occurring in the knee of a boy of ten years. Motion was markedly limited and while at operation the fragment could not be found, the patient regained perfect function in the knee. Fairbank<sup>4</sup> operated upon a case of osteochondritis dissecans in the knee of a girl of nine years. She had had

\* From the Department of Orthopedic Surgery, Albany Hospital. † Dr. Strange is now a Lieutenant in the Medical Corps of the United States Naval Reserve.

pain and swelling for the previous six months. The results of the treatment were not noted. Freund<sup>1</sup> also states that he heard of the case of a boy of ten years, who was said to have had a "free joint body" removed from his knee joint.

This case is reported because it is a child of only four and one-half years. The youngest child with osteochondritis of the knee reported in the literature reviewed was nine years. It is thus seen that while it is thought that this is a disease of adolescence, this is not necessarily true. It is also worthy of note that in this case, conservative treatment led to complete cure, whereas open operation is usually recommended.

#### CASE REPORT

A boy of four and one-half years was admitted to the Pediatric Service of the Albany Hospital on October 21, 1941. His chief complaint was general malaise and moderate lameness in both legs for the previous three days. The mother had also noted a slight limp in the left leg for that period. Physical examination was negative except there was slight limitation of motion of the left knee and some pain was caused by this motion. Blood findings, including calcium, phosphorus and phosphatase were normal. Examination of the spinal fluid revealed no abnormalities. Anterior poliomyelitis was suspected as this boy was admitted in the midst of a severe epidemic of that disease. However, this was quickly ruled out.

X-ray of the left knee on October 22, 1941, (Fig. 1), revealed a definite small defect,

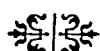
apparently in the medial posterior articular surface of the epiphysis of the femur. Within this defect, but almost completely detached, was a small fragment of bone measuring about 2 mm. in dimension. Diagnosis of osteochondritis dissecans was made and the patient was transferred to the Orthopedic Service and a plaster cast applied to the extremity with the knee in a slightly flexed position. The patient was discharged from the hospital, but was not allowed to bear weight on the leg. On December 6, 1941, the cast was removed, after having been in place for six weeks. X-rays at this time showed that the defect had filled in completely. The child was allowed to resume weight bearing and x-ray on February 4, 1942, (Fig. 2), showed that the defect had remained healed. At this time the patient had absolutely no symptoms, examination was entirely negative and the patient was regarded as entirely well three and one-half months after the onset of his symptoms.

#### SUMMARY

A case of osteochondritis dissecans occurring in the knee of a child of four and one-half years is reported. Conservative treatment led to complete cure within a few months. It is thought that this is worthy of report. As far as can be noted, no case has been reported in one so young.

#### REFERENCES

1. FREUND, ERNST. *Arch. Surg.*, 39: 323, 1939.
2. GOLD, AARON J. *Bull. Hosp. Joint Dis.*, 1: 30, 1940.
3. ARCHER, V. W. and PETERSON, C. H. *South. M. J.*, 23: 611, 1930.
4. FAIRBANK, H. A. T. *Brit. J. Surg.*, 21: 67, 1933.



# MESENTERIC THROMBOSIS OF THE TERMINAL ILEUM\*

## CASE REPORT

WILLIAM T. DORAN, M.D.  
Consulting Surgeon, Bellevue Hospital

AND WILLIAM T. DORAN, JR., M.D.  
Assistant Visiting Surgeon, Bellevue Hospital

NEW YORK, NEW YORK

**T**HERE have been seventeen cases of mesenteric thrombosis in Bellevue Hospital during the past five years. One patient left the hospital one hour after admission and before operation; fifteen patients have died and this is the report of the seventeenth case.

This case report is presented to illustrate one thing namely, that the McBurney incision was most adequate in this situation. The resection of the lower ileum and secondary anastomosis to the ascending colon was accomplished without difficulty and without waste of time or shock to this patient and with no sacrifice of maximum utility to the patient.

### CASE REPORT

A seventy-seven year old white male was admitted to the Fourth Medical Division of Bellevue Hospital on August 26, 1941, at 3:00 A.M. On admission he stated that he had been attending clinic for one month for arthritis which had somewhat restricted his activity. Despite this he had noticed some shortness of breath on exertion during this period. One hour before admission he awoke with pain all over his abdomen which caused him to vomit food but no blood. The pain rapidly increased in severity but had remained generalized, although it became more marked in the upper abdomen. For fifteen minutes before admission the patient had a chill and complained of feeling weak, cold and clammy.

His past history revealed that he had undergone a double inguinal herniorraphy in 1918. There was no cardiac or intestinal symptomatology except moderate chronic constipation. Venereal disease was denied.

Physical examination revealed an acutely ill,

elderly, small moderately well nourished white male. His temperature was 98°F.; pulse 48 regular, blood pressure 180/95. The abdomen was not distended but was tender throughout; this tenderness was most marked in the lower abdomen. No rigidity or involuntary spasm was elicited. There was rebound tenderness throughout. The cardiac examination was not remarkable; urinalysis was negative; white blood count 21,000; polymorphonuclears 92 per cent.

After admission the pain subsided somewhat. The patient appeared subjectively improved; tenderness became more localized to the right lower quadrant with moderate spasms. His blood pressure fell to 130/85; bradycardia persisted below 60. The patient vomited twice after admission and had a normal bowel movement shortly after admission both of which were negative for blood. The Wassermann test was negative.

Surgical consultation was asked and it was our opinion that acute appendicitis was the most probable diagnosis. Celiotomy was performed thirteen hours after admission after supportive infusion was given.

Cyclopropane anesthesia was used throughout. A standard McBurney incision was used. When the peritoneum was opened sanguineous exudate was found in the abdomen. A gangrenous intestine presented moderately distended. On investigation this proved to be ileum and to involve the lower four feet of ileum to the ileocecal valve. The mesentery showed thrombosis of the branches of the superior mesenteric artery and its radicals in a fan-shape supplying this area. The ileum was resected and an end-to-side iliocecostomy performed to the ascending colon at a point approximately two inches distal to the ileocecal valve. An ileostomy was performed one

\* Presented before the Section on Surgery of the New York Academy of Medicine, April 10, 1942.

foot proximal to the site of anastomosis, and 10 Gm. of sulfanilamide powder were placed in the abdomen.

Sulfathiazole, transfusions, oxygen tent, infusions and Miller Abbott suction were used postoperatively. Fluids were allowed shortly after operation. The ileostomy tube was removed on September 1st, the sixth postoperative day. Sutures were removed on the

ninth day after operation. The ileostomy fistula closed spontaneously on the eighteenth post-operative day and the patient was discharged on September 22nd, the twenty-seventh day after operation.

The pathological report showed the gangrenous bowel lumen to contain exudate and transudation of red cells and typical infarction of the mesenteric vessels.



AN inflammatory condition, similar to regional ulcerative colitis, may involve segments of the small intestine, usually the terminal part of the ileum. Pathologically, this condition is somewhat like "chronic ulcerative colitis." The history will usually be of long standing, recurrent, progressive diarrhea, with abdominal cramps, loss of weight, low grade fever and anemia.

The brief excerpts in this issue have been taken from "The Modern Management of Colitis" by J. Arnold Bargen (Charles C. Thomas).

# New Instruments

## A NEW RHINOMETER

MORTON I. BERSON, M.D.

Director of Plastic and Reconstructive Surgery, The Downtown Hospital and Pan-American Clinic  
NEW YORK, NEW YORK

TO obtain esthetic results in rhinoplasty, the author has devised a sterilizable rhinometer. It is useful in

The instrument consists of the following parts:

a. Two rests fitted under the superior

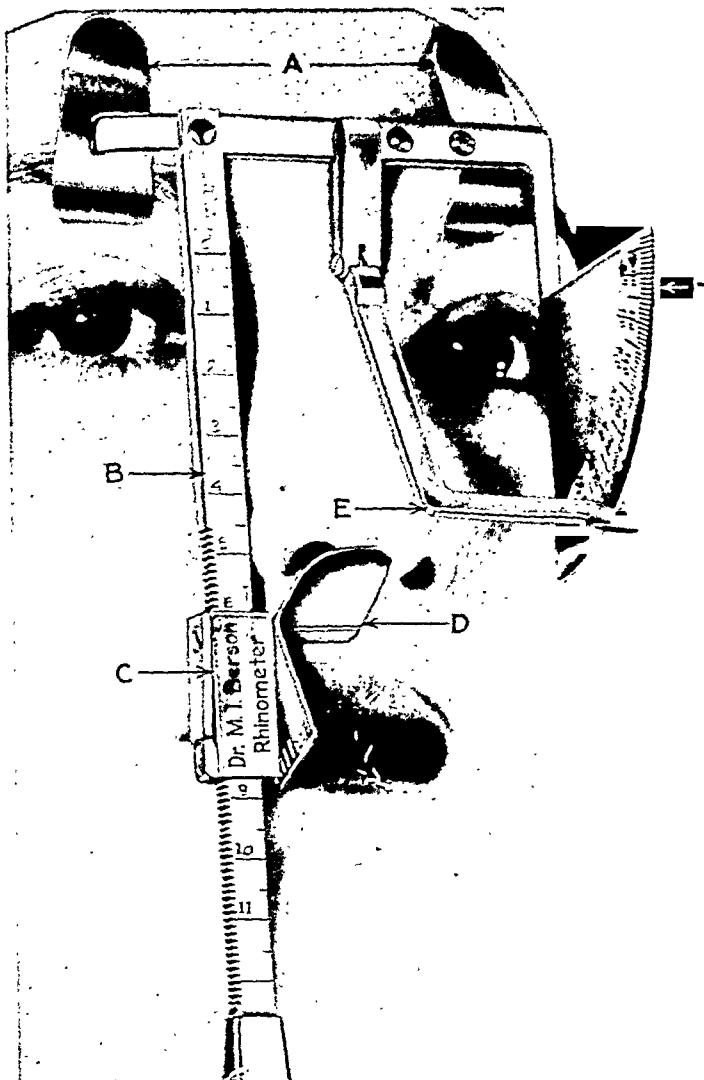


FIG. 1. Author's rhinometer. (*The Laryngoscope*, April 1943.)

the diagnosis of nasal deformities and is valuable in progressive checking of the required normal measurements during nasal operations.

orbital crests in conjunction with the base of the platform **D**, which is placed at the columella lip junction, act as fixed points from which accurate measurements are made.

B. A vertical column with a numerical scale designed to carry the sliding platform D, and to record the length of the nose.

C. A cross-member carriage designed to slide the platform to various levels along the column. Then according to the graduated scale, the difference between the actual length (from nasion to apex) and the desired length is measured.

D. The platform fits under the columella lip junction of the nose and can be tilted to the desired esthetic angle registered on the calibrated scale.

E. The lever on the calibrated arc F is adjusted to the normal profile angle, i.e., the degree of projection of the nose from the face, and the excess to be removed is then determined.

By the use of the rhinometer, the following absolute measurements can invariably be attained. The length of the ideal nose is one-third of the facial length. The superior

third is from the hairline to the nasion. The third occupied by the nose is from the nasion to the tip of the nose. The lowest third is from this point to the tip of the chin or gnathion. The normal tilt angle is 95 degrees; this varies slightly according to the relationship with the lower third of the face. In cases of short or receded chins, this angle can be tilted to 105 degrees. The profile angle or projection of the nose is determined by a line drawn from the glabella to the root of the nose. The lever E is so adjusted to measure the desired height of the nose on the calibrated scale F. The ideal nasal profile angle should measure 30 degrees.

The rhinometer is important in determining the exact amount of tissue to be removed, and besides its practical value, it has also a reassuring effect on the patient when he or she sees that the surgeon is not operating haphazardly but has a definite scale and plan.



## SURGEON'S THUMB GOWN

A. E. DREXEL, M.D.

Attending Surgeon, Halifax District Hospital

DAYTONA BEACH, FLORIDA

I doubt if many surgeons can put on a pair of sterile dry gloves without at some time during the procedure di-

terior of the glove. This fact can be proved by making the following experiment: Paint unsterile parts with some highly colored solution and then see where it may be deposited when the gloves are on. The so-called *thumb gown* makes this error practically impossible.

An ordinary surgeon's gown with a stockinette cuff is required. In the sewing room, maintained in almost all hospitals, a strip of ribbon tape is sewed to the end of the cuff into a loop as illustrated in Figure 1. The thumbs find these loops without any difficulty when putting on the gown. A nurse holds open the gloves and with one diving motion the surgeon's hands are placed full depth into the gloves without further ado. The surgeon never touches either glove with the other hand.

The advantages of this gown are obvious and need no further explanation. I have used this gown now for the past four years and have found it of increasing value and satisfaction.



FIG. 1.

rectly or indirectly cause some portion considered as unsterile to come into momentary contact with the sterile ex-



# The American Journal of Surgery

Copyright, 1944 by The American Journal of Surgery, Inc.

A PRACTICAL JOURNAL BUILT ON MERIT  
*Fifty-third Year of Continuous Publication*

NEW SERIES VOL. LXIII

FEBRUARY, 1944

NUMBER TWO

## Editorial

### PILONIDAL CYST

**I**N recent months the subject of pilonidal cyst has been discussed frequently in American medical literature. Not uncommonly two or more articles dealing with similar or slightly differing phases of the condition have appeared in single issues of distinguished scientific journals. Space in several periodicals has been given for repeated reviews, serial case studies, statistical analyses, and the evaluation of technical procedures.

Obviously surgeons, authors, and editors realize the urgent need for improvement in the therapeutic approach to what has been for too long a tantalizing and harassing surgical enigma. Likewise, there is manifest a concerted eagerness to assist in resolving the problem; and a number of writers are making an effort to express the merits or defects of various technics, to encourage further investigation and to present a rational exposition of principles.

Circumstances are more propitious for vanquishing obscure complicating factors in the surgical eradication of pilonidal cyst than at any time in the history of the world. Surgery has attained an inestimable degree of perfection. Global conflict entails the concentration of millions of men in the armed forces. The vast majority of these fall into the age group (twenty to thirty) in which pilonidal cysts are most commonly encountered, and literally hun-

dreds are being operated upon in army hospitals. The assignment of newly recruited troops to regions of warmer, if not equable, climate and the swift pace of training promotes glandular activity and the rapid accumulation of excretory products of the skin, macerated epithelium and dirt, which are significant elements in the activation of pilonidal cyst symptoms. Mechanization of warfare with its consequent vigorous jolting of combatants against scantily cushioned, metallic vehicular seats, accounts for a considerable percentage of symptom initiating incidents among members of mechanized units. The trauma induced during obstacle course maneuvers, particularly in the scaling of wall barricades, and that resulting from a stay of several successive days on bivouac, where protection and personal hygiene must be neglected, engenders adverse local reactions in new and is responsible at times for the dissolution of recently healed cases.

The treatment of contaminated but not grossly infected or abscessed pilonidal cysts consists of the removal or destruction of the cyst and its epithelial ramifications, but there is conflicting opinion as to how this can be most satisfactorily accomplished. For the most part surgeons practice radical excision and differ mainly in their method of closing the wound. Depending upon personal preference, but also

in large measure upon conditions encountered, block dissection (sharp or cautery) with open packing, partial closure, or complete primary suture of the wound are the procedures of choice. Radiation therapy and the use of sclerosing solutions, while effective in a small series of cases, are impracticable in most military hospitals. Plastic repair, like closed operations, results in a sufficient number of persistent or recurrent examples as to oppose its routine adoption.

The inapplicability of a solitary approach to all cases tacitly signifies the inadequacy of present standards. Whatever the recommended plan of therapy, it is subject to unequivocal deficiencies: prolonged or delayed healing, recrudescence of infection, infection with dissolution and recurrence.

Heretofore it was observed that, in unselected cases, wide excision and open packing offered the least chance of recurrence. However, the gratification of permanent benefit was vitiated by the delay in healing as well as by the inconvenience and time loss of the patient. Likewise, when cases were carefully selected, the reported results of partial or complete closure were largely unsatisfactory.

With the advent of war the time element in the development of an effective armed resistance assumed unprecedented proportions and attention was promptly focused upon the excessive number of man hours lost from training because of pilonidal cyst and its complications. Surgeons, quick in their response to the generously displayed verbal spur, "Minutes count," earnestly endeavored to improve the situation. Cases were reclassified and the technic moderately amplified, particularly through the local application of the sulfonamides and the use of non-absorbable suture mate-

rial, but most noticeable was the definite trend toward primary, complete closure of the wound.

The majority of pilonidal cysts are contaminated and, therefore, are imbued with a potential of bacterial activity. In consequence, they should be surgically eradicated as early as possible and the wound promptly closed. More than half the cases examined show some degree of inflammation and not infrequently there is a history of abscess or drainage from a sinus.

Conservative treatment, indicated in acute inflammation or abscess, should be employed as a temporizing measure in preparation for radical surgery. If the inflammatory condition is subacute, or nearly resolved, and narrowly confined within the limits of the proposed elliptical incisions, radical operation may be performed at once; but if the inflammatory process is disseminated, or if pus is present, a minimum period of three weeks should elapse between the disappearance of inflammatory signs and bloc excision.

Recently an increasing number of patients, unselected except insofar as the presence of pus is concerned, are being treated by a revised closed method in which non-absorbable sutures are used and in which chemical bacterial inhibitors are omitted. The investigation thus far has shown that rather startling results are in the making.

Surgeons should continue in their endeavor to decrease the morbidity of pilonidal sinus. They should be encouraged by the realization that the future holds more in store for them than was known in the dilatory past. They should profit by the great, unpredictable opportunities that lie ahead.

MAJOR J. WILLIAM WHITE, M.C.



# Original Articles

## BONE GRAFTS TO THE MANDIBLE\*

GORDON B. NEW, M.D. AND JOHN B. ERICH, M.D.  
ROCHESTER, MINNESOTA

**B**ONE grafting is a subject which has come to occupy a relatively important place in discussions on traumatic injuries of the lower jaw. All bony defects interrupting the continuity of the mandible, whether the loss of bone is due directly to the injury or indirectly to necrosis following an infection, disturb to some degree the natural relation of the upper and lower dental arches, the normal masticatory mechanism and the symmetry of facial contour. Such maxillary changes call for readjustments and in the majority of instances there is little question but what a bone graft offers the most satisfactory method of repair. In the armed forces at the present time, mandibular injuries of this type are encountered fairly frequently and in all probability the number of such defects will increase noticeably in the near future. Consequently, it is reasonable to assume that bone grafting will become a comparatively common procedure in maxillofacial surgery.

There can be no doubt that much of the success of maxillary bone grafting depends on a most painstaking type of aseptic surgical technic and on the construction of dental and mechanical appliances which will maintain adequate immobilization of the bony fragments during the healing period. However, absolutely aseptic technic and perfect fixation do not always insure success. Other factors are sometimes present which ultimately lead to discouraging results. Unfortunately, these factors too frequently can neither be discovered before operation nor be coped with satisfactorily after operation.

### CAUSES OF FAILURE OF BONE GRAFTS

A study of the causes which contribute to failures of bone grafting requires first an appreciation of the biologic and physiologic processes concerned in regeneration and repair of bone. Experiments conducted by many research workers seem to indicate that all or at least the greater portion of a bone graft undergoes gradual death. However, as the implant dies, new bone is formed to replace the dying bone. Shortly after transplantation, the graft becomes enveloped in a vascular form of fibrous tissue supplied by the bed in which the graft is placed. Excavations soon occur on the external surfaces of the implant and as the vascular tissue penetrates into the Haversian canals, a similar slow destructive process occurs in the Haversian system. Simultaneously with the foregoing activities, osteoblasts make their appearance on the surface and in the bony canals of the graft, and promptly begin to produce new bone. It is thought that physiochemical substances released by the disintegrating transplant stimulate the formation of new osseous tissue.

Much controversy exists as to the origin of the osteoblasts. Some authors believe that they are derived from the periosteum and endosteum of the graft as well as from the ends of the bony fragments. Others take exception to this hypothesis and believe that all osteoblasts transplanted with the graft die; it is their opinion that, while some of the osteogenic cells producing new bone in and about the graft are derived from the fragments, the greater number

\* From the Section on Laryngology, Oral and Plastic Surgery, Mayo Clinic.

arise as the result of metaplasia of undifferentiated connective tissue cells enveloping the graft. Although, at the present

most frequent cause of infection undoubtedly is a nick or a tear through the oral mucous membrane accidentally produced

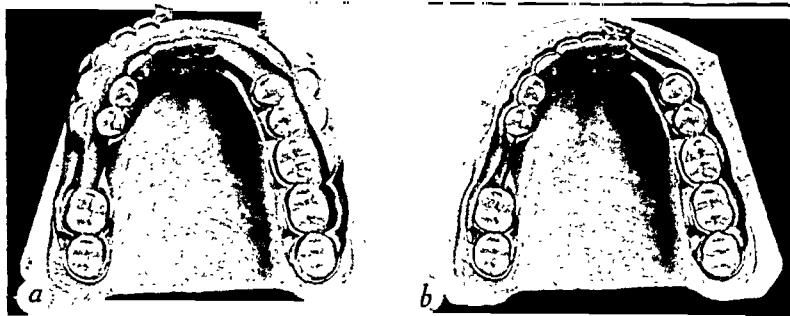


FIG. 1. Sectional hinged splint cast of silver for retaining the fragments of the lower jaw in correct alignment prior to a bone graft operation. This type of splint is used when several teeth are present in each fragment. *a*, splint open; *b*, splint closed and locked about the teeth by a wire passed around the divided button.

time, there is no way of determining the origin of these bone-forming cells, the problem is not without clinical significance, as will be pointed out later.

To sum up the physiologic processes which occur in the transplantation of bone, one might say simply that the graft is destroyed gradually and more or less completely and is replaced by newly formed bone which fuses with the ends of the bony fragments. The rapidity with which this phenomenon of destruction and substitution occurs depends to a large extent on the density of the transplant; the denser the bone, the more slowly will it be disintegrated and replaced.

In most instances, failures of bone grafting are the result of infection. The presence of pathogenic bacteria is likely to produce a rapid destruction not only of the cellular elements of the graft, but also of the osteogenic cells so essential to formation of new bone. In consequence, the implant becomes a sort of foreign body which ultimately is extruded. From a clinical standpoint, familiarity with the etiologic factors that favor the development of infections about bone grafts is most essential. It is always possible, of course, to carry pathogenic bacteria into the wound by improper sterilization of instruments or by faulty surgical technic. However, the

during the operative procedure. Even though such perforation may be extremely insignificant, it affords the means by which secretions from the mouth can enter and contaminate the wound.

Unfortunately, the source of some infections about bone grafts is not so obvious. Bacteria invading the wound at the time of the original injury may lie dormant in the tissues for many weeks without being destroyed and without causing any clinical evidence of infection. But on the introduction of a bone graft into the region, the subsequent inflammatory reaction stimulates these organisms to produce an acute infectious process. A latent infection then is a constant potential danger in bone grafting. It is imperative, therefore, that sufficient time elapse between the occurrence of the bony defect and the bone graft operation to free the tissues of all pathogenic organisms. Just how long the period between these two events should be is a matter of conjecture. It is our opinion that the insertion of a bone transplant to correct a mandibular bony defect of traumatic origin is best deferred for three or more months following the injury. If the loss of bone is due to necrosis or osteomyelitis, the patient then should be entirely free of symptoms (that is, swelling, discharge, pain or sequestra) for six to nine months

before the implantation of a bone graft is undertaken. While somewhat arbitrary, these time intervals in general are adequate.

proceed with the insertion of a bone graft, scar tissue forming between the fragments gradually pulls them together and disturbs

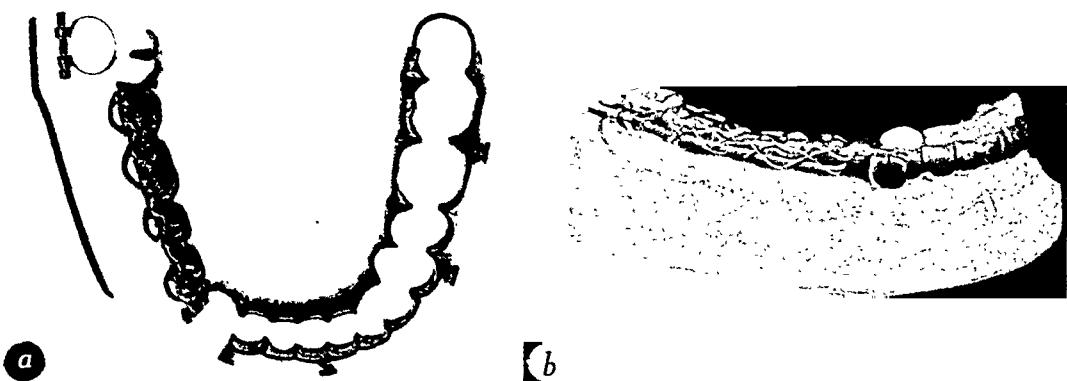


FIG. 2. Divided, hinged silver splint employed for immobilization when there is but one molar tooth in the posterior fragment. *a*, the splint spans the edentulous region of the lower jaw. An orthodontic molar band is placed around the single molar tooth in this fragment. A bar inserted in the sheath of this band and wired to the loops on the silver splint joins together the splint and molar band and, in turn, immobilizes the fragments; *b*, the bar wired in place, and the splint locked about the teeth by a wire passed around the divided button.

An infrequent but very definite cause for failure of bone grafting is the presence of extremely dense, avascular scar tissue intervening between and surrounding the ends of the bony fragments. Here, the blood supply is so poor that not only is adequate vascularization of the graft impossible but the production of osteogenic cells is markedly inhibited. Under these circumstances a bone graft is likely to undergo rapid death and sequestration.

Before dismissing this subject of etiologic factors which are responsible for failures of bone grafting, we should like to interject this thought: There can be no question but what in certain cases a bone graft does not "take" because there are lacking in the patient the necessary physiochemical and cellular reactions essential to the physiologic destruction and regeneration of the graft. Fortunately, this cause for failure of the transplantation of bone is rare.

#### MAINTENANCE OF THE FRAGMENTS OF THE MANDIBLE IN NORMAL POSITION DURING THE PREOPERATIVE PERIOD

During the interval of waiting between the time at which a portion of the mandible is lost and the time at which it is safe to

their entire relation to the upper jaw. Moreover, the teeth themselves tend to shift, this displacement often becoming so marked that the former occlusion between the upper and lower teeth can never be restored. Shortly after the original injury it is desirable, therefore, to construct for each individual case an appliance which will maintain the fragments in their normal positions. What type of mechanism should be constructed depends entirely on the number of teeth present in each fragment.

When each fragment contains several teeth, a sectional hinged splint made of one of the acrylic compounds or silver (we prefer the latter) is ideal (Fig. 1). Such a splint consists of three sections hinged together posteriorly by half round wires. When it is placed about the teeth, the buccal segments are held together by a wire passed around a divided button. This appliance depends for retention, not on cement, but on its grip in the interdental spaces; and since it does not cover the occlusal surfaces of the teeth, there is no interference with occlusion. Finally, such a splint can be removed easily at frequent intervals for cleansing of the teeth and maintains the fragments in perfect position for any desired length of time.

In a mandible in which there is but one molar tooth in a short posterior fragment, it is inadvisable to use this type of splint



FIG. 3. A cast silver splint with a buccal flange to be used for immobilization when several teeth are present in the long anterior fragment but none in the posterior fragment. The flange rides on the buccal surface of the opposing upper teeth and thereby prevents mesial displacement of the long anterior fragment.

since it does not afford sufficient stabilization for the two fragments. Under these circumstances, we have devised a divided, hinged splint made of cast silver (Fig. 2); this is attached around the teeth of the long anterior fragment and spans the edentulous region in which there is a loss of bone. Attached to the molar tooth in the short posterior fragment is an orthodontic molar band which when screwed down cannot be displaced. The cast silver splint and molar band are then connected together by a rod which is wired securely to lateral loops on the former and which fits into the buccal sheath of the latter. Such a splint supplies the necessary fixation of the fragments.

Should there be several teeth in the anterior but none in the posterior fragment, it is advisable to construct a cast silver splint with a buccal flange (Fig. 3). This splint is cemented to the posterior teeth of the long fragment and, as the patient opens and closes his mouth, the

flange rides on the buccal surface of the opposing upper teeth. If such an appliance is used, the long anterior fragment cannot be displaced mesially and can maintain its proper relation to the upper dental arch. Although the posterior fragment is likely to be rotated upward by muscular traction, it can be replaced later on. This same splint is to be recommended for retaining the mandible in position when one of the ascending rami is lost.

If both lower fragments are edentulous, there is no splint available for retaining the fragments in their normal positions. However, this problem is of no significance even though scar tissue does pull the fragments together, since the final contour of the lower alveolar ridge is of no great importance in an edentulous mandible.

If the fragments of a mandible in which there is a bony defect are not immobilized by some form of splint and are permitted to be drawn together by scar tissue, this scar must be incised to permit replacement of the fragments in their original relation to the upper jaw. This is particularly important in cases in which teeth are present in one or both fragments. Ordinarily, we incise the intervening scar tissue by means of a scalpel or scissors, cutting first through the oral mucous membrane and carrying the incision down across the dense scar below. When completely free, the two fragments can be manipulated easily into their former position and stabilized by one of the splints already described. Following such a procedure, the problem of infection of tissue again arises, necessitating deferral of a bone graft operation for at least three months.

Before one proceeds with the transplantation of bone to the mandible, it is most essential that every tooth whose roots are located near the ends of the fragments be extracted. Usually, we prefer that at least 2 cm. of bone beyond the free edge of each fragment be devoid of teeth. There is but one exception to this rule: If a tooth situated near the end of a fragment is the only means of fixation for that part of the

mandible, it should be retained. However, under these circumstances the bone graft must be attached to the fragment in a manner differing from the usual procedure. The removal of all teeth which will interfere with the application of a bone graft must be carried out at least three months prior to the insertion of the transplant. In fact, it is desirable to extract such teeth as soon as possible after the original injury, and preferably before a splint is constructed for the immobilization of the fragments. May we stress here the importance of obtaining good dental roentgenograms of all patients who are to have a bone graft applied to the mandible; by this diagnostic aid all teeth in the mandible which are infected or which will interfere with the proper application of the graft can be visualized clearly.

#### TECHNIC OF OPERATION

Two factors are essential to successful bone grafting: perfect asepsis and perfect immobilization. Since the mechanical devices for fixation of the fragments must be applied the day before the insertion of the transplant, this phase of the technic will be discussed first. Any appliance designed for fixation of the fragments must be more than a mechanism that merely holds the fragments; it must be an agent which maintains correct dental occlusion. Furthermore, it must be so constructed that it will give adequate immobilization during the time necessary for the graft to unite with the fragments, a period usually of six to eight weeks. Here again, the type of fixation to be used in each case depends entirely on the teeth which are present in the segments of the lower jaw and in the maxilla. Different types of fixation are shown in Figure 4.

In bone grafting to the mandible, we disapprove of the use of the many appliances which have been designed for external skeletal fixation. The most undesirable feature of these devices is that they are likely to interfere with the surgical exposure of the fragments and with the

application of the graft. In addition, the bone pins or screws used with such appliances have a tendency to become loose before a strong bony union has developed between the graft and the fragments, thus permitting more or less displacement of the graft. Then, too, such appliances add a certain degree of risk to the operation, because of the remote but possible development of infection or necrosis in the tissues surrounding the pins or screws.

*Fixation of Fragments of the Lower Jaw, Both Containing Several Teeth.* Under these conditions, we employ a sectional hinged splint, such as has been shown in Figure 1. The buccal segments of this appliance are constructed with external buttons or with hooks for the attachment of intermaxillary wires. Applied to the upper dental arch is a half round or full round wire arch bar, which is made secure by wiring to each upper tooth. It is inadvisable to use on the upper teeth single loop or continuous loop wires, as these may tend to stretch and gradually permit some displacement of the segments of the lower jaw. Strong intermaxillary wires connected to the arch bar above and to the hooks on the silver casting below complete the steps necessary for thorough immobilization of the fragments.

*Fixation of Fragments of the Lower Jaw in Which There Is but One Tooth in the Posterior Fragment.* A cast silver splint is constructed for the mandible, such as has been shown in Figure 2. This appliance, when securely attached to an upper arch bar by means of intermaxillary wires, affords a means of perfect fixation for the fragments. (Fig. 4a.)

*Fixation of Fragments in Which There Are No Teeth in the Posterior Fragment.* In this situation, the long fragment containing teeth is made immovable by means of intermaxillary wires stretched between half or full round wire arch bars. The posterior fragment, on the other hand, is pulled backward and immobilized by a wire which is attached to a hook incorporated in a plaster head cast. (Figs. 4b and 5.)

In surgically exposing the angle of the mandible for insertion of a traction wire, blunt dissection should be employed so

insertion of this traction wire has entirely disappeared before proceeding with the transplantation of the bone graft. Usually,

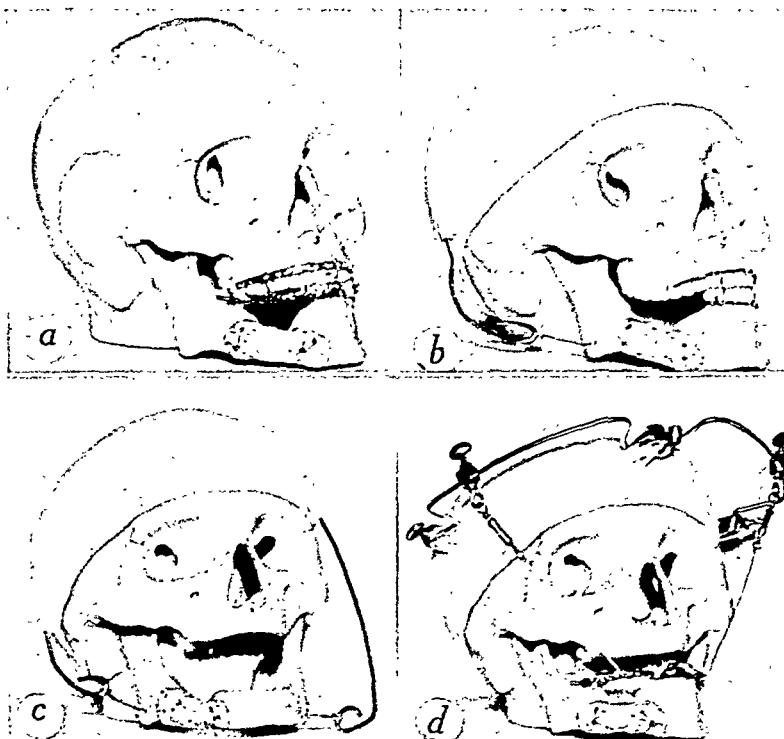


FIG. 4. Methods of fixation for the fragments of mandibles which have a bony defect requiring a bone graft. *a*, appliances used when there are teeth in both lower fragments; *b*, when there are no teeth in the posterior fragment; *c*, when the mouth is edentulous and *d*, when there are teeth in both lower fragments but none in the upper jaw.

that no fibers of the facial nerve in the overlying soft tissues will be severed. Muscular attachments at the angle of the lower jaw are stripped away by periosteal elevators. Following exposure of the angle itself, a hole is made through the bone by means of an electrically driven drill. A double strand of wire (we prefer No. 26 gauge bronze or stainless steel wire) then is inserted through this hole and twisted in such a fashion that it can be attached later to the hook on the head cast. Finally, the soft tissues of the wound are sutured about the wire.

Care should be taken in this operative procedure to expose no more of the angle of the mandible than is absolutely necessary. It is also advisable to wait until the inflammatory reaction subsequent to the

this is a matter of about three weeks. It is to be remembered that this wire, when under tension, can pull completely through the bone in six to eight weeks. Therefore, in order that it shall provide immobilization of the fragment during the six to eight week healing period of the bone graft, it is important that this wire be left unattached to the plaster head cap hook until the day before the bone graft operation. This form of immobilization does not prevent slight mesial or lateral displacement of the edentulous fragment. However, this amount of motion does not interfere with healing of the bone graft.

*Fixation of the Fragments When Both Fragments of the Lower Jaw Are Edentulous.* Under these circumstances, there is no entirely satisfactory method of immobiliza-

tion for the fragments. However, as is shown in Figure 4c, wires attached to the two fragments and fixed to a plaster head

wires which are attached to the splint on either side are passed through the soft tissues of the cheeks and are fixed to a



FIG. 5. Bony defect of mandible. *a*, before operation; *b*, posterior fragment pulled back into position by a wire inserted near the angle and fixed to a plaster head cast. The anterior fragment is immobilized by intramaxillary wires. *c*, postoperative view of the mandible with the bone graft in position. Fixation appliances have been removed.

cast, under ordinary circumstances, give sufficient fixation.

*Fixation for the Fragments When There Are Teeth in Both Lower Fragments But None in the Upper Jaw.* In this situation, a sectional hinged splint, such as is shown in Figure 4d, is used. In addition, traction

plaster head cast above. We believe that such traction wires are a distinct advantage in providing added fixation in cases in which there are no upper teeth present to which intermaxillary wires can be attached.

*Fixation of the Fragments When But One or Two Molar Teeth Are Left in Each Frag-*

ment. Frequently when the loss of bone involves the anterior portion of the mandible, but one or two lower molar teeth are

basis for making a selection of the region possessing bone most suitable for grafting. Since a bone graft undergoes a process of

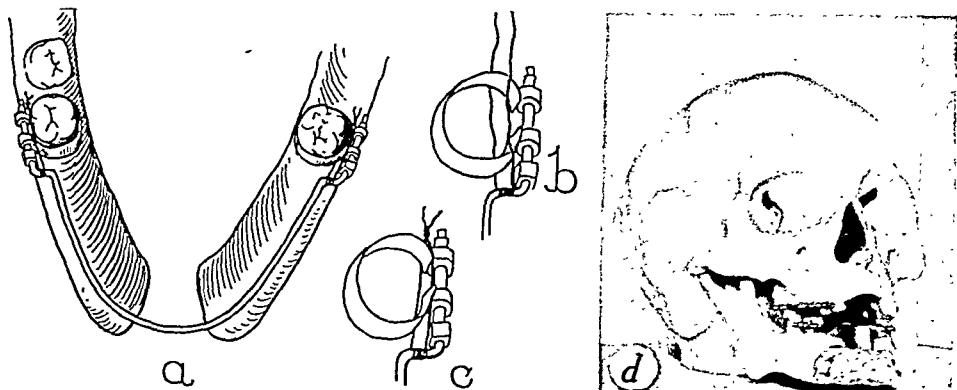


FIG. 6. Method of fixation of the fragments of a lower jaw in which there is an anterior defect and in which there is present only one molar tooth in each fragment. *a*, an orthodontic band is attached to a molar tooth in each fragment and a round wire arch bar, properly bent, is inserted into the buccal sheaths of the bands. *b* and *c*, a wire twisted around the arch bar on either side and then twisted about the side of the sheath of each molar band prevents the arch bar from being displaced. This bar maintains the desired distance between the fragments. *d*, intramaxillary wires from the lower molar bands to the upper teeth immobilize the lower fragments.

left on either side for fixation. Regardless of whether these teeth are loose, they should be retained for fixation of the fragments. However, when so few teeth remain, it is useless to employ a sectional splint. Instead, we attach an orthodontic band to a molar tooth in each fragment; then a round wire arch bar properly bent is inserted into the sheaths of these molar bands so as to maintain the desired distance between the fragments. (Fig. 6.) Complete immobilization is obtained by intermaxillary wires stretched between the upper teeth and the sheaths of the molar bands below.

*Choice of Bone for Graft.* The anatomic regions from which sections of bone can be obtained for implantation over the mandible are numerous. The tibia, crest of the ilium, ribs and clavicle have been used for this purpose. In addition, sliding inlay grafts from the jaw bone adjacent to the defect have been employed. Just which one of these sites offers the best type of bone for transplantation is a debatable question. In view of the experimental work which has been done by many workers in recent years, there should be some scientific

gradual disintegration and of regeneration, it would seem that the logical type of graft to use would be one which is composed of bone that is somewhat spongy or porous. Not only has it been demonstrated that a graft made up of extremely compact bone is vascularized slowly but its union to the jaw fragments also is much delayed when compared with the time required for the completion of these physiologic processes when the graft is porous and cancellous. There has been much discussion in the literature as to whether or not a graft should possess much cancellous bone. Although some experimental work would indicate that an excess of bone marrow has a detrimental effect on the tissue reactions about a bone graft, it is our opinion that a rather porous type of graft possessing some cancellous bone will give better results generally than will one composed of very compact bone.

Taking the foregoing factors into consideration, we believe that bone obtained from the crest of the ilium or from a rib is preferable to that obtained from other sites. Their histologic structure is very similar; both contain much cancellous

bone with a moderately thin layer of cortical bone. On the other hand, sliding inlay grafts from the mandible and im-

double-beveled chisels are employed to obtain a piece of bone of the required size. On removal of the graft from its bed, it is

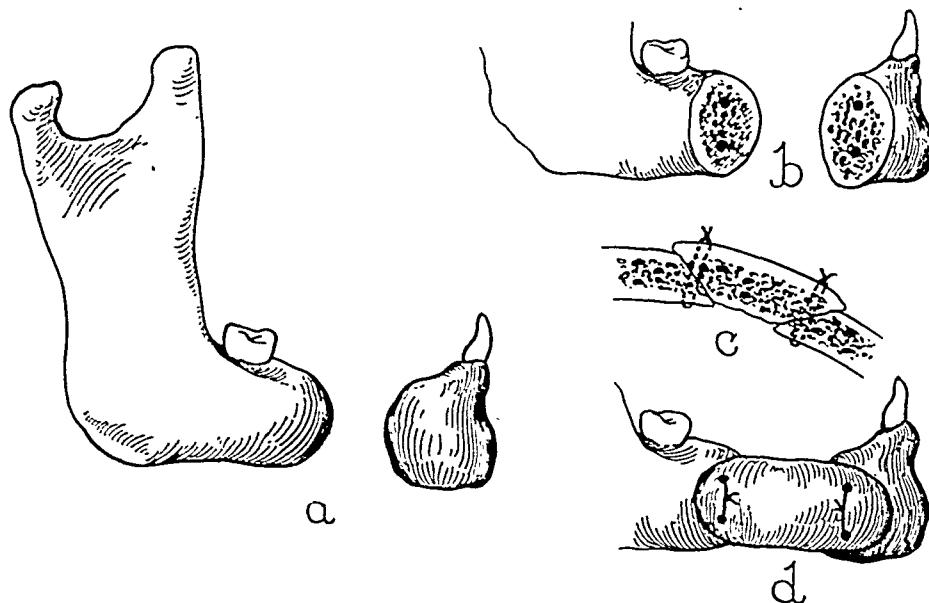


FIG. 7. Surgical preparation of the bony fragments for reception of a bone graft. *a*, the relation of the fragments to the defect is demonstrated; *b*, the end of each fragment has been ground down and beveled outward, exposing the cancellous bone. Two holes have been drilled in each fragment. *c*, bone graft (as seen from below and in cross section) has been cut to fit between the two fragments. Two heavy catgut ligatures inserted through the holes maintain the bone graft in proper position. *d*, bone graft tied in position (as seen from the buccal surface).

plants from the tibia are composed of bone which is too compact to warrant their use. Bone from the clavicle we also do not employ, because anatomically it is a poor source of bone for transplantation.

If one wishes to employ costal bone, we recommend cutting out a section of rib of the necessary length and splitting it longitudinally into halves; one or the other half is then selected for grafting. Since it is technically more difficult to secure bone from a rib than from the ilium and since it causes the patient more postoperative discomfort, we have chosen the crest of the ilium as the best site from which to obtain bone for grafting the mandible.

In removing bone from the ilium, a slightly curved skin incision passing down below the crest is used. After the subcutaneous tissues have been incised, periosteal elevators effectively remove the muscular attachments to this bone. When the crest is completely exposed, very thin,

well to insert a drain which provides an outlet for the escape of any serum which may collect in the depths of the sutured wound.

There has been considerable difference of opinion as to whether or not a graft should possess its periosteal covering. Experimental work along this line would indicate that the cellular elements of the periosteum die shortly after the graft has been placed in position, but the presence of the periosteum aids in an early attachment of the surrounding connective tissue to the implant. Apparently, whether or not a graft is covered with its periosteum makes little difference in the ultimate healing of a bone graft but we think it preferable not to remove the periosteum.

*Preparation of Site.* Before one proceeds with the implantation of a bone graft into the mandible, all of the appliances necessary for fixation of the fragments must be in proper position. This

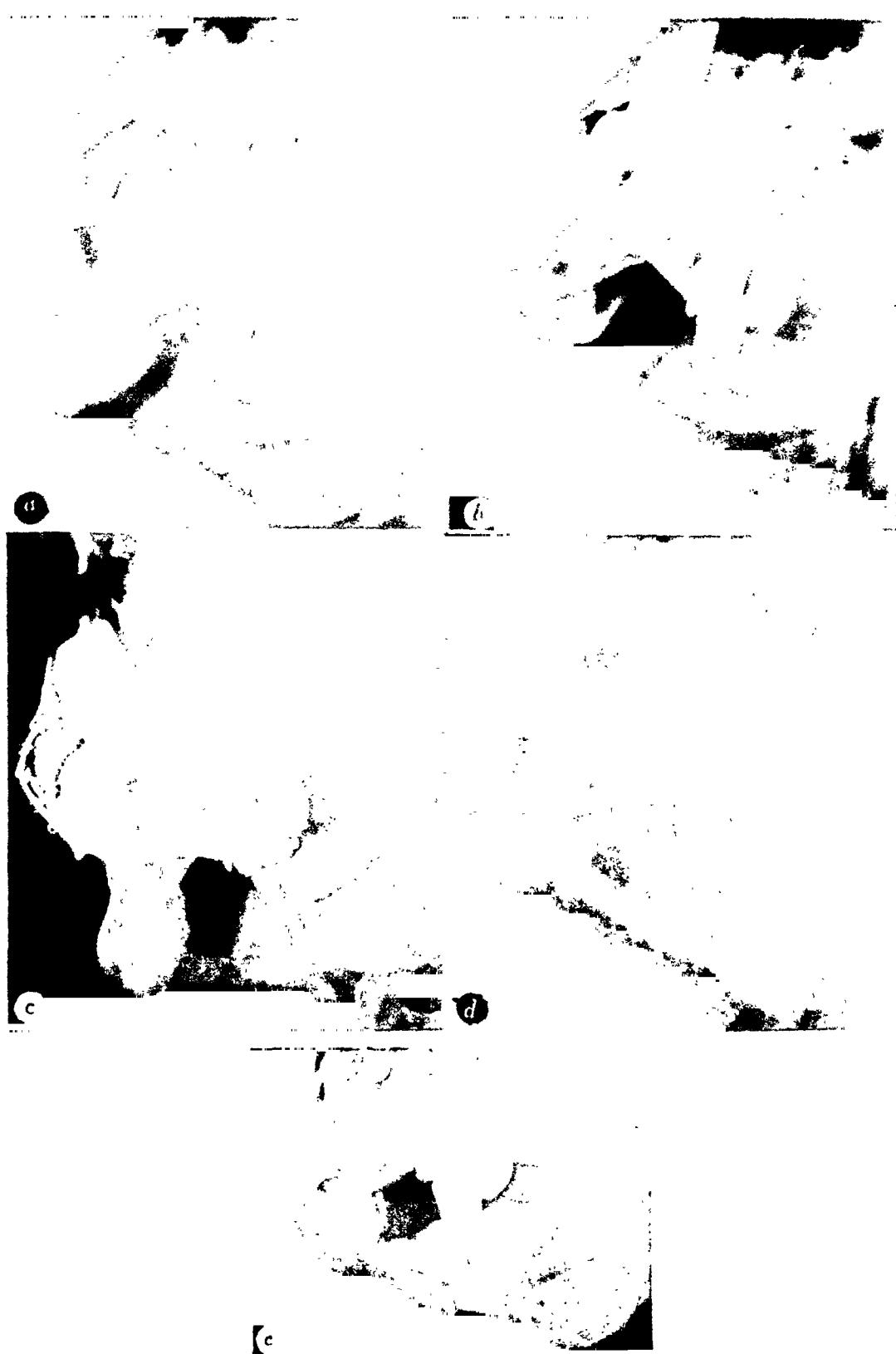


FIG. 8. For descriptive legend see opposite page.

type of operation progresses with the least amount of difficulty if performed with the patient under intratracheal gas and other anesthesia. Just below the mandibular defect, a cutaneous incision of sufficient length to give adequate exposure of the ends of the fragments is made. It is advantageous to make this incision at least 2 cm. below the lower border of the mandible, so that injury to the small branches of the facial nerve which supply a portion of the lower lip may be avoided. By blunt dissection, the ends of the fragments are exposed and with periosteal elevators the soft tissues surrounding the ends of the fragments are pushed aside. The most vulnerable point for a nick or tear through the oral mucous membrane is along the upper edge (alveolar ridge) of each fragment. However, adequate exposure of the ends of the fragments can be obtained without freeing the soft tissues over the alveolar border. Consequently, we believe that the tissues here should be left entirely alone, thus avoiding a possible perforation through the oral mucous membrane.

Following exposure of the outer (buccal) and inner (lingual) surfaces, as well as the lower border of each fragment, the free end is ground down and beveled outward for a distance of about 2 cm. (Fig. 7.) The grinding is continued until bleeding occurs from the cancellous portion of the bone. In this preparation of the end of the bony fragment, it is desirable to grind away the bone with a motor driven burr rather than to remove it with chisels, because the force exerted by a mallet or a chisel is sufficient to displace the dental appliance needed for subsequent fixation of the fragments. The foregoing technic completes the preparation of the fragments for reception of the bone graft.

*Insertion of Graft.* By means of rongeurs

and bone chisels, the transplant itself is cut to the desired shape and its ends are beveled to approximate the ends of the bony fragments. Two holes are drilled through the ends of the fragments as well as through each end of the bone graft and by use of heavy dermal catgut the graft is tied to the fragments. (Fig. 7.) It is our opinion that wire, kangaroo tendon or other nonabsorbable material should not be used for attachment of the bone graft. Instead, one should rely on the mechanical devices already described for fixation. The ligature need hold the graft for only ten days to two weeks, at the end of which time sufficient fibrinous exudate and loose fibrous tissue will have formed to maintain the implant in the desired position. Consequently, we believe that it is better to use some material, such as catgut, which is absorbable. Following implantation of the graft, the soft tissues are sutured tightly without drainage. In the average case, immobilization is maintained for six to eight weeks.

Through a personal communication, we have been informed that many surgeons in England are employing cancellous bone chips from the crest of the ilium to correct bony defects of the mandible. These chips are merely packed into the wound between the fragments, no attempt being made to fix them in position. In our experience, such bone chips give satisfactory results if the width of the bony defect does not exceed a few millimeters. However, when there is a considerable loss of bone we believe that a good functional result can be obtained only by using a single piece of bone to bridge across the defect. In general, we prefer a rather large graft, even though its margins may protrude beyond the normal contour of the mandible. Any excess or protuberance of a

FIG. 8. Bone defect of mandible. *a*, preoperative view; *b*, appliances for immobilization are in position.

The posterior fragment is held backward in its correct position; *c*, bone graft in position. Because of the fact that the tooth in the posterior fragment is close to the end of the fragment, the bone graft has been placed along the lower border of this fragment, so as to gain a greater contact surface between the fragment and the graft. *d*, bone graft healed; fixation appliances have been removed; *e*, two years after operation, the projection of bone along the lower border has become rounded off and the new bone has been built up between the two fragments, strengthening the entire mandible.

bone transplant will undergo a gradual process of resorption, so that ultimately this is done, the graft has a broader surface of attachment but also may protrude

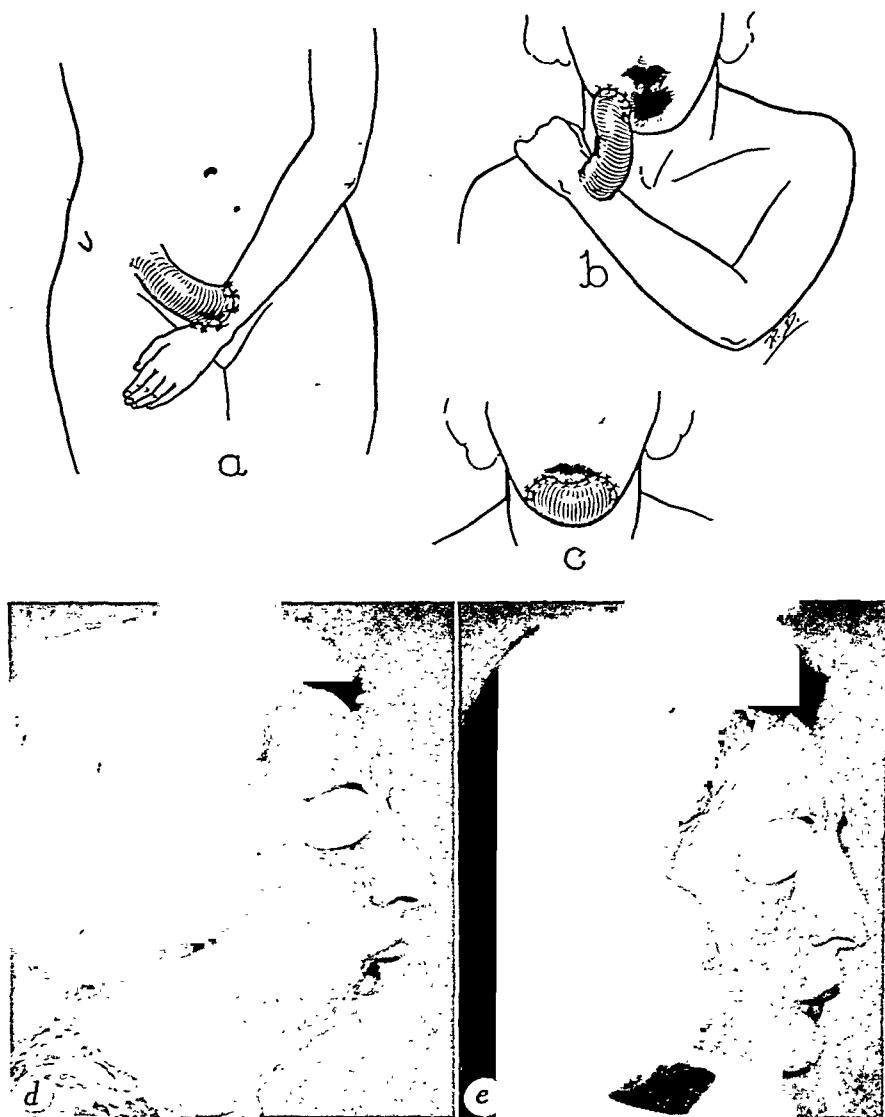


FIG. 9. Loss of the soft tissues of the chin occurring in conjunction with a loss of bone in the anterior part of the mandible. In cases such as this, the soft tissues must be reconstructed several months before a bone graft can be applied. *a*, *b*, and *c*, reconstruction of the soft tissues of the chin by means of an abdominal-wrist tube flap; *d*, preoperative view of the patient; *e*, postoperative view; the soft tissues of the chin have been reconstructed and a bone graft has been inserted.

the normal configuration of the mandible in the region of the defect will be established.

When, for reasons of immobilization, it is necessary to retain a tooth whose roots are located close to the end of a fragment, we prefer to attach the bone graft to the fragment below that portion of the bone which surrounds the roots. (Fig. 8.) If

conspicuously below the lower border of the mandible. This projection of the graft we do not attempt to remove. As is shown in Figure 8, all of this excess bone is absorbed gradually and the ultimate contour of the mandible is essentially normal.

The most common causes for failure of a bone graft to unite to a fragment are

(1) poor apposition of the graft to the fragment, (2) insufficient surface contact skin graft containing much fat before one can proceed with a bone graft. (Fig. 9.)

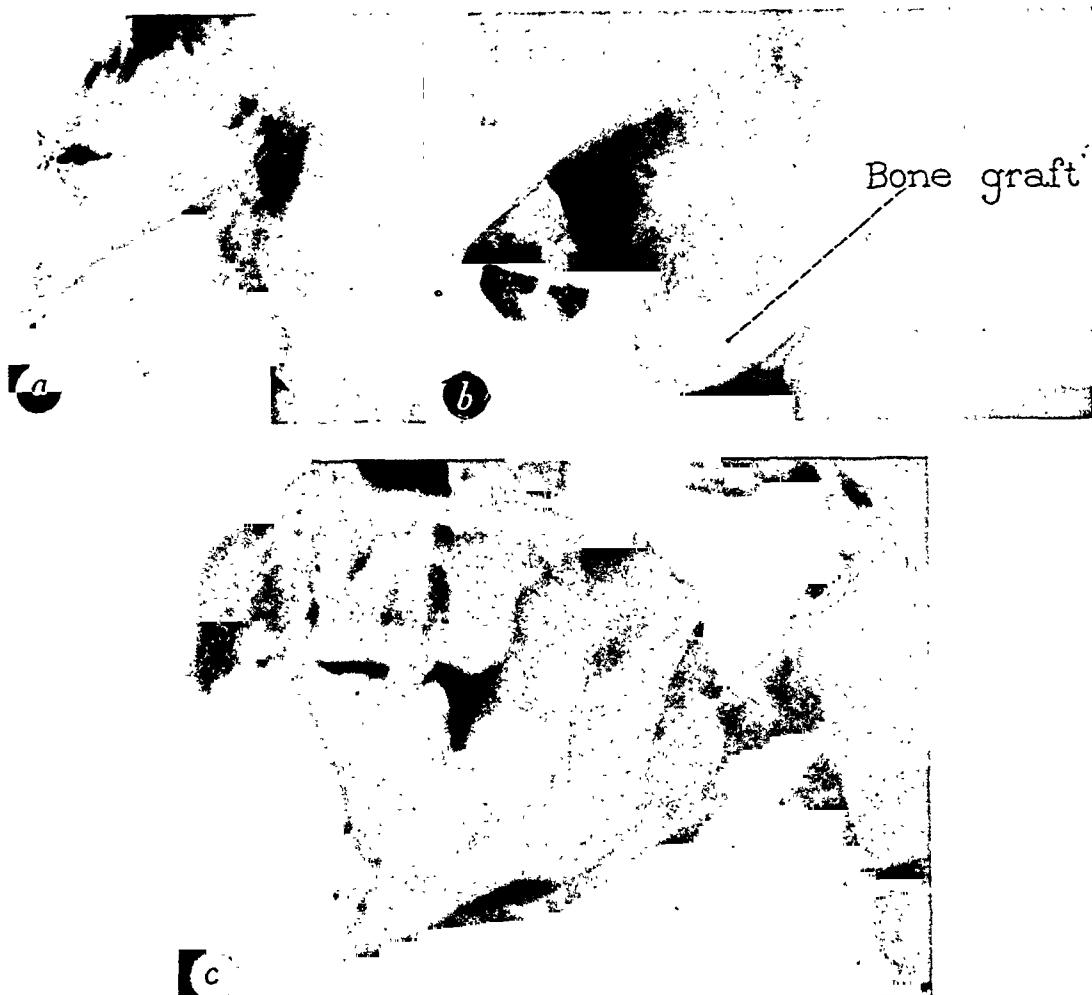


FIG. 10.—Loss of one ascending ramus of the mandible repaired by a bone graft obtained from a rib. *a*, before operation; *b*, after operation; *c*, sixteen years after operation.

between the ground-down end of the fragment and the end of the graft and (3) sclerosis of the end of the fragment. While it is not essential that the graft and the end of the fragment fit flush, still there should be as wide a contact surface as possible. This is accomplished by grinding the surfaces until they rest firmly together. Should the end of a fragment be sclerosed or eburnated, it should be ground away until healthy cancellous bone is reached, as exhibited by proper hemorrhage.

Occasionally, particularly in war wounds, a defect of the mandible is associated with a loss of the overlying soft tissues. In such instances, it is necessary to reconstruct the soft tissues using some form of tubed

#### RECONSTRUCTION OF ASCENDING RAMUS

The loss of one ascending ramus of the mandible is a fairly common war injury. Such a defect seriously interferes with mastication since the remaining portion of the mandible is drawn to the affected side. In constructing the lost part by means of a bone graft, it is to be remembered that the graft itself is never concerned with the subsequent functions of the mandible; it merely retains the lower jaw in its proper relation to the upper dental arch. It is our opinion that if the loss of bone extends forward beyond the region of the premolar teeth on the affected side, the defect is too extensive to warrant the

use of a bone graft. This is true because the graft would be too bulky and heavy for the remaining portion of the mandible

conforms to the contour of a normal ascending ramus. One must, of course, use the iliac bone corresponding to the side

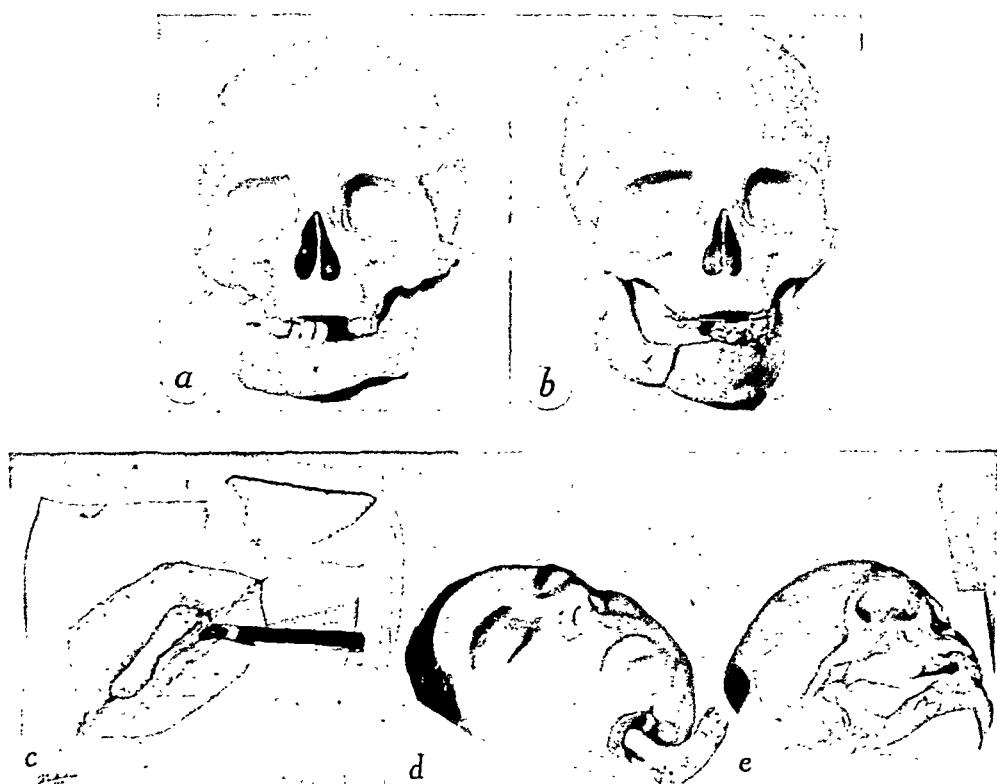


FIG. 11. Loss of the right ascending ramus of the mandible. Defect corrected by means of a bone graft obtained from the ilium. *a*, defect and displacement of the mandible; *b*, appliances for fixation of the mandible in position. The bone graft which has been cut from the right ilium is in place. *c*, removal of a section of bone from the ilium; *d*, the bone graft has been trimmed to the proper size and is being inserted. The anterior superior spine of the ilium makes an excellent angle for the reconstructed portion of the mandible. *e*, bone graft ligated to the free end of the mandible.

to operate during mastication. Under such circumstances, one must consider the use of a prosthesis rather than a bone graft, even though the former is none too satisfactory.

For reconstruction of the ascending ramus and a portion of the body of the mandible, either a rib (Fig. 10) or the crest of the ilium (Fig. 11) can be employed. In our experience, both are satisfactory, although we prefer the crest of the ilium since its anterior superior spine forms an excellent angle for the reconstructed ramus. (Fig. 11*c* and *d*.) As a matter of fact, bone taken from the crest of the ilium can be trimmed to a shape which very nearly

of the defect and measurements of the graft must be determined in advance. The soft tissue about the ilium is stripped away until sufficient bone is exposed and, on removal, rongeurs and chisels cut the section of bone to the desired configuration. (Fig. 11.) After the mandible has been immobilized by dental wiring, a small cutaneous incision is made below the free end of the mandible. With a blunt forceps, a tract or cavity is created deep to the masseter muscle, extending from the incision to the glenoid fossa. Technically, this is not difficult to accomplish if one proceeds with caution. Next, the free end of the jaw bone is exposed, ground down

and beveled outward as has been described previously. The graft itself is inserted into this artificially created tract and attached by a catgut ligature to the prepared end of the mandible. A satisfactory functional and esthetic result may be anticipated if the operative procedure is carried out aseptically and if immobilization of the mandible is secured by mechanical devices.

#### PREVENTION AND TREATMENT OF INFECTION

Since infection is the most serious complication involving bone grafts, this subject deserves considerable attention. Sprinkling a small amount of powdered sulfathiazole or other sulfonamide compound into the wound after transplantation of the graft is to be recommended. There can be little doubt that these drugs aid in overcoming many infections. However, should the wound become grossly contaminated by secretions from the mouth entering through a nick in the oral mucous membrane, one local application of these drugs probably would be ineffectual. Should a definite purulent infection develop about a bone graft, the implant need not necessarily be lost. For such cases, we have found it helpful to insert a small through-and-through rubber tube drain alongside the

graft. Usually this drain can be inserted through one draining sinus and brought out through another sinus or counteropening. That part of the tube which is situated within the wound should possess multiple perforations, and this drain is joined externally to a salversan by a Murphy drip connector. By means of this apparatus, diluted solution of sodium hypochlorite (modified Dakin's solution) is permitted to flow very slowly and continuously through the wound for several days. In our experience, this procedure has been definitely effective in saving a few infected bone grafts. It is possible that other solutions such as one of sulfanilamide, if used in a similar manner to irrigate the wound, might produce as good or better results.

From the foregoing discussion, it is evident that despite the refinements of surgical technic which have been developed in recent years, failures of bone grafting still occur. This fact should discourage the indiscriminate use of such transplants to correct every ununited fracture or bony defect of the mandible. Only when the loss of bone actually interferes with dental occlusion and with mastication is there a legitimate indication for the use of a bone graft.



# CESAREAN SECTION\*

## THE RATIONAL USE OF THIS OPERATION

DENVER M. VICKERS, M.D.

Diplomate of the American Board of Surgery; Attending Surgeon to Mary McClellan Hospital  
CAMBRIDGE, NEW YORK

**O**F the studies and surveys on maternal mortality that have come and gone during the past decade, cesarean section has almost routinely received unfavorable comment. The question in our own minds as to whether this unfavorable attitude was entirely justified, prompted us to make this study of one hundred consecutive patients coming to abdominal section for delivery in a rural hospital.

Jameson,<sup>1</sup> in a review of obstetrics in northern New York state, several years ago tabulated 5,914 deliveries from a number of different hospitals and found 135 cesareans for that year or an incidence of 2.2 per cent. In this series there were only two deaths in the cesarean patients, or a 1.5 per cent cesarean mortality.

Gustafson<sup>2</sup> reported 366 cases from Indianapolis with a cesarean incidence of 4.8 per cent, and an average cesarean mortality of 8.4 per cent, starting at 18.1 per cent in 1928 and coming down to 2.0 per cent in 1935.

Lynch,<sup>3</sup> from San Francisco, collected a large series of figures from public health reports and found that a quarter of the maternal deaths were in those cases which had had cesareans. His average mortality figure for 12,955 cesareans was 4.1 per cent, with an incidence of 2.5 per cent in 524,117 deliveries.

Stander,<sup>4</sup> in 1935, estimated the average mortality of the operation was around 10 per cent.

Quigley,<sup>5</sup> in 1937, collected 11,994 cases with 526 deaths, or a rate of 4.38 per cent. Of these, his own personal series of 264 cases showed only one death, or 0.3 per cent. The component figures varied from a mortality of 14.6 per cent to 0.

In New York City in 1930, 1931 and

1932, 2.2 per cent of all deliveries were cesarean.<sup>6</sup>

The figures on mortality of maternal cases published from New York, Philadelphia, Indianapolis<sup>7</sup> and Chicago showed that in private practice, cesarean operations were more frequent than in open-ward hospital series, suggesting the effect of economic pressure. But it was also shown that a fifth of the mortality in the New York city series occurred in cases that were submitted to cesareans.

This figure does not, of course, say anything about the number of patients with cesareans that got well, and undoubtedly some of those operated upon would have died without operation. But the gross figures were suggestive, especially to the laity, and perhaps have been one factor in abating pressure on the doctor to "do something" when the patient is in labor and in pain.

Since the publicity given maternal death rates during the past few years, maternal mortality statistics have been better. Death rates for puerperal causes in 1931 was 616 and in 1938, 414,<sup>8</sup> and there is every reason to believe that the present figure is lower still.

The emphasis on obstetrics has been more effective in promoting proper training of the young physician. Maternal morbidity and mortality in the next decade and next generation should be better still.

The improvement in maternal care apparently has come in all its branches. Better prenatal care has been brought to public attention, so that now the patients do come to the doctor earlier; better handling of toxemia and eclamptic patients has lowered the mortality in that list; better and more selective operative methods have done their part as well in reducing mortality.

\* From the Mary McClellan Hospital, Cambridge, New York.

There is still room for improvement and all surgeons, obstetricians and general practitioners welcome the criticisms that have arisen, in so far as it gave guidance for better obstetrics in the future.

Cesarean operation in its initial concept seemed to offer immediate solution to many problems that have plagued every obstetrician from the earliest days. As the peritoneal cavity was invaded more and more safely by the surgeon for various and increasingly detailed procedures, it seemed obvious that anatomically, at least, incision of the uterus was a relatively simple matter, and would avoid all the pitfalls that beset delivery through the natural channels.

But the early statistics on cesarean operations showed that the operation itself had its difficulties and that sepsis and hemorrhage were more often encountered than in delivery by the usual methods. So for a considerable period of time, the operation was looked upon as a surgical possibility, but not one that the careful surgeon would attempt without good and sufficient reasons or one in which the risk of delivery in the usual manner was too great. As an operation of last resort, the patients were poor risks to begin with and the mortality was proportionately raised. Therefore, the whole procedure deservedly was held in bad repute.

During the past few years in the Mary McClellan Hospital, a rural hospital of one hundred beds, a hundred cesareans have been done without maternal mortality. (Table I.) These have been done by the writer or by two other men under his direct observation and, therefore, represent a standard technic of procedure.

TABLE I

Number of deliveries.....	2192
Number of cesareans.....	100
Cesarean incidence.....	4.4%
Maternal cesarean deaths.....	0
Maternal mortality .....	0 %

During this time there were 2,192 deliveries with a cesarean incidence of 4.5 per cent.

The fact that a series of one hundred cesarean operations can be done without mortality seems definitely encouraging and

would tend to put cesarean operation in a more favorable light. Where there is need for such an operation, we believe this series proves that it can be done. Any operation is associated with a certain risk and any surgeon, if he operates long enough, will encounter several of the many unaccountable accidents of surgery; but the risk in this operation should be no more than in many other more standard procedures.

*Technic.* The technic of operation at our clinic is undoubtedly similar to that used elsewhere. We have no "secret" methods. We wish to emphasize that good results follow care in the ordinary details of surgery.

The patient is prepared in the usual manner with the exception that we are careful not to give morphia or other sedatives for the few hours immediately before operation. We believe that morphia especially and other sedatives to a lesser extent do cut down the respiratory activity of the fetus, and a few cases of fetal asphyxia may have been due to this factor. This withholding of sedatives is admittedly in marked contrast to our practice and the practice of surgeons generally for operations of other types in which preoperative sedatives are grateful.

Our anesthesia is usually nitrous-oxide-ether. This is quick and the patient goes under with a minimum of difficulty. The mother and baby receive plenty of oxygen. At the time of birth of the baby the oxygen can be raised or the ether practically cut off so that the baby usually breathes promptly. After operation is completed, the patient is given whatever sedatives are necessary.

The abdomen is incised in the mid-line. Ordinarily, the incision is between the umbilicus and the symphysis; but if this distance happens to be short, we do not hesitate to go above the umbilicus. At about the time the uterus is exposed, an ampule of pituitrin is given hypodermically, which induces the uterus to contract at about the time it is incised. A transverse flap is dissected free over the lower portion of the uterus, separating and protecting the bladder from injury, and giving an addi-

tional flap over the lower end of the uterine incision. The uterus is then incised in the mid-line as low as is convenient, but usually with about half of the incision above and half below the level of the transverse flap.

An effort is made to prevent gross contamination of the peritoneal cavity by the amniotic fluid, by using suction, or by using pressure of the hands on the sides of the abdomen as the amniotic sac is opened.

If the incision is low and small enough to allow the baby's head to go through, there will be no need for "walling off" and the intestines, etc., will not be exposed. Postoperative adhesions should therefore be few; but if the omentum is available, it is pulled into the field over the uterine incision before the abdomen is closed.

The baby is extracted by the feet; the uterus will probably be torn a bit if the baby is large but the tear can be repaired as readily as an incision and bleeds less. The cord is clamped and cut and the placenta expressed. The vertical incision is repaired with several layers of continuous chromic catgut. The transverse flap is then reaproximated over the lower portion of the incision and the abdomen closed in the usual fashion.

Postoperatively we have found that a tight Scultetus binder holds up abdominal tension, prevents intestinal distention, and gives the patient great comfort for the first week postoperatively. If distention once develops, it is difficult to control but must be cared for by the usual methods, and often is an index of subclinical peritoneal infection.

The type of operation, we believe, is of lesser importance than the way in which it is done. DeLee's low cervical operation is a good one, but DeLee was a good technician, and his operation really called attention to good technic. An incision in the mid-portion of the uterus is usually more convenient than one either too high or too low; it avoids important structures so that it can be repaired more readily and it heals well.

Extraperitoneal cesarean section has been described and the fact that it can be done is a tribute to the operator's skill and

anatomical knowledge. But it is technically difficult and not well adapted for routine use. The exposure is inadequate and the occasional operator might well run into trouble or else violate the peritoneum, spoiling the whole intent of the scheme. Our series does not include any extra-peritoneal operations.

Our series does include one Porro cesarean or hysterectomy after cesarean, occurring in a rupture of the uterus. Probably this should be classified primarily as a hysterectomy instead of a cesarean. This is a rare accident of obstetrics but the possibility must be kept in mind.

In this series, we had four still-births and eight neonatal deaths. (Table II.) This seems high and most of these did occur in the first half of the series before our ideas on the general subject had crystallized. But one still-birth followed rupture of the uterus, the accident occurring before admission to the hospital, another in a severe eclamptic condition and two others in premature separation of the placenta.

TABLE II

Number of births.....	160
Still births.....	4
Neonatal deaths.....	8
Causes of Still Births	
Rupture of uterus.....	1
Eclampsia.....	1
Premature separation of placenta.....	2
Total.....	4
Causes of Neonatal Deaths	
Malformations.....	2
Prematurity.....	4
Unaccounted for.....	2
Total.....	8

Of the neonatal deaths, two had malformations inconsistent with life over any period of time, and four others were premature, operation having been done to avoid further risk in the mother. The viability of the baby in premature separation of the placenta varies with the amount of separation which cannot be accurately determined before delivery. Some of these patients we operated upon, knowing that the odds were against a live baby, but the patient was willing to chance a quick delivery in the hopes that the fetal circulation might still be adequate.

The indications for cesarean operations are given in the textbooks. Clinically speaking, they come down to a relatively few categories. (Table III.)

TABLE III  
INDICATIONS

Dystocia.....	55
Toxemia of pregnancy.....	16
Previous cesarean.....	11
Placenta previa.....	7
Cardiac disease.....	4
Elderly primipara.....	2
Premature separation of placenta.....	3
Rupture of uterus.....	1
Presistent transverse presentation.....	1
Total.....	100

The most common question is that of disproportion. When the presenting part, usually the baby's head, does not come down into the pelvic inlet at the time labor begins, especially in a primipara, something is wrong; and if the contraindications can be satisfied, cesarean section may be the answer.

Perhaps the baby is too big; perhaps labor should have been induced a few weeks before; perhaps the pelvis is small, which may or may not have been proved by x-ray. If the baby's head still rides high after good pains have started, which can be determined usually by abdominal examination without the risk of a pelvic examination, something is at fault. Therefore, the time for action is before the best minutes and hours are lost.

Secondly, placenta previa happens often enough to be seen occasionally in any hospital. There are other methods of dealing with this, all of which have their uses and their advantages in particular instances; but if the baby is viable and if the mother is in surgical condition, cesarean is one of the safest ways out for both. If the baby is dead or if the mother is moribund, do not perform a cesarean operation; the results are just not worth the risk.

Incidentally, a postmortem cesarean section is usually a feeble gesture. The baby, except under most unusual circumstances, dies before the mother.

Toxemia is another question. The treatment of eclampsia is now apt to be more

conservative, but it is still true that the syndrome usually is relieved after the uterus is empty. If the patient is a primipara, or if the cervix is long and firm, and if the patient has recovered from the worst stages of her eclampsia and the baby is viable, it may be a relief to get the baby as quickly and as easily as possible, which is via cesarean.

Separation of the placenta is another complication that occurs more often than the textbooks indicate.

If the fetal heart is good and the baby is not too small, cesarean may save it before the blood supply is further cut off; while delivery in the normal manner, taking much more time, might prove too much for the already damaged circulatory supply. We have had fetal mortality when we guessed wrong on this question, but I am sure we have saved several babies that would have had little chance otherwise.

Previous cesarean is an indication that is relative but usual. A few of our former cesarean patients have delivered themselves normally before we had a chance to do any further investigating. But usually the worry about the scar in the uterus is enough to make any surgeon advise cesarean again if the patient has had one, no matter what the original indication may have been. One or two of our patients have had four; quite a few have had three; and there is no reason why they could not have more cesarean sections but most of them do not.

This factor does influence the decision in the younger patients; for if they have this form of operative delivery once, they may have to have it again which may be awkward, inconvenient or even dangerous. On the contrary, an elderly primipara may have a cesarean on less rigid indications for she may never have another pregnancy.

Intercurrent disease, tuberculosis at a minimal stage, heart disease, or uterine fibroids and the like, may occasionally be indications; and if the risks one way or the other can be medically balanced, the operator should be able to reach a decision with a calm mind.

On the side of the contraindications, cesarean section should be avoided when the patient has been in labor so long as to be physically tired out, or has had several or many pelvic examinations or even a trial of labor or forceps, or has a fever on admission. Even though she may have been under inadequate care in her own home, where factors could not be controlled, do not "stick out your own neck" just to take the burden from the shoulders of the attending obstetrician.

Cesarean section in the past got poor results because it was saddled with many of the poor risk cases, the "failed-forceps" cases, or the cases in which the patients had been in labor for lengthy periods under poor surroundings. Remind yourself of this occasionally and keep your own mortality rate down.

If at all possible, a definite plan for the operation or at least for its consideration should be made. If the pelvis seems narrow to external examination, it can be checked by x-ray. Roentgenographic pelvimetry is becoming more standardized and does give real information.

In the border-line case, the patient may be allowed to go into labor, even allowed to rupture the membranes, but in our series we found that the rise of temperature postoperatively seemed definitely correlated with the length of time labor had been under way. Therefore, the decision should be made fairly quickly. (Table IV.)

TABLE IV  
MORBIDITY

Number of patients with fever to 100.4°.....	33
Number of patients slightly toxic.....	20
Number of patients moderately toxic.....	8
Number of patients severely toxic.....	5
Causes of Morbidity in 33 Cases	
Prolonged trial of labor.....	38.4%
Unknown.....	23.
Placenta previa.....	15.4
Eclampsia.....	15.4
Pyelitis.....	7.7

Ryder<sup>9</sup> reported 330 cases from the Doctors Hospital in New York, which showed a definite decrease in morbidity among those patients operated upon before labor really developed. Ryder in this series

showed more morbidity in the low-flap operations than in the classical, which proves that there may be two sides to the question in spite of the widespread recognition of DeLee's operation.

The advent of the sulfa drugs in surgery gives a considerable increase in the feeling of safety. Intraperitoneal sulfathiazole and sulfanilimide in our hands has greatly diminished the morbidity and mortality in other diseases as appendicitis and perforated gastric ulcer. There seems no reason why these drugs should not be used intraperitoneally in potentially infected cases. Probably actually infected cases should not be risked with our present knowledge but the border line is obscure. In our own series, we used sulfathiazole by mouth in one case with good results, the fever reaching 101°F. on only one day.

From this study, we gain the impression that when the conditions can be rightly satisfied, cesarean section offers an opportunity to avoid many of the complications associated with a difficult labor. It is necessary to stay between the two extremes, not offering cesarean as a method for all patients, and on the other hand, not delaying too long or neglecting the opportunity for cesarean when it might have been useful. In competent hands, in circumstances in which the technical details can be adequately cared for, cesarean section offers less risk than many of the more difficult and technical obstetrical maneuvers invading the uterine cavity from below. In this series, we have never been sorry that we did a cesarean operation; rather there are other patients for whom we wish we had elected this operation in time.

#### REFERENCES

1. JAMESON, E. M. *New York State J. Med.*, 35: 125, 1935.
2. GUSTAFSON, G. W. *Surg., Gynec. & Obst.*, 64: 1045, 1937.
3. LYNCH, F. W. *Surg., Gynec. & Obst.*, 64: 336, 1937.
4. STANDER, H. J. *Am. J. Obst. & Gynec.*, 29: 559, 1935.
5. QUIGLEY, J. K. *New York State J. Med.*, 37: 543, 1937.
6. Special Article. *J. A. M. A.*, 101: 1826, 1933.
7. SMITH, D. L. *J. A. M. A.*, 108: 1334, 1937.
8. Editorial. *J. A. M. A.*, 114: 963, 1940.
9. RYDER, G. H. *Am. J. Obst. & Gynec.*, 41: 1029, 1941.

# CARCINOMA OF THE GALLBLADDER

## A CLINICAL AND PATHOLOGIC STUDY

JAMES L. VADHEIM, M.D.,  
Fellow in Surgery, Mayo Foundation

HOWARD K. GRAY, M.D.  
Division of Surgery

AND

MALCOM B. DOCKERTY, M.D.  
Division of Surgical Pathology, Mayo Clinic  
ROCHESTER, MINNESOTA

IN 1777, Stoll of Vienna published the first authentic record concerning primary carcinoma of the gallbladder with necropsy data in two cases.<sup>2</sup> Since that time approximately 2,000 cases<sup>2</sup> have been added to a growing literature in which for the most part the factors of etiology, incidence, association with cholelithiasis and various peculiar pathologic features of the lesions have been stressed. However, the progress made along the lines of early recognition of carcinoma of the gallbladder has been disappointing. Numerous articles bear testimony to the fact that the condition is insidious in its onset and often reaches a stage beyond the scope of surgical removal before it becomes clinically manifest as a malignant condition. For this reason it was considered worth while to report the clinical and pathologic data gleaned from a study of seventy-seven cases of relatively early primary carcinoma of the gallbladder in which the gallbladders were removed surgically at the Mayo Clinic from 1907 to 1940 inclusive.

### MATERIALS AND METHODS

Clinical records in seventy-seven surgical cases of carcinoma of the gallbladder were secured and carefully analyzed for pertinent clinical and laboratory data and surgical end results. The pathologic specimens then were obtained and studied carefully in gross detail. In two cases specimens were not available for pathologic examination. In sixty-five of the seventy-five cases in which specimens were available the entire gallbladder was studied.

Special attention was paid to the site, size and consistency of the lesion, the presence of regional lymph nodes and any adventitious tissue, the presence or absence of gallstones and so forth. These data were all carefully recorded. Multiple blocks of tissue were then cut from the primary lesion, surrounding uninvolved portions of the wall of the gallbladder, regional nodes and adjacent hepatic tissue when available. These blocks were placed in 10 per cent solution of formalin and cut with a freezing microtome; the sections were fixed with hematoxylin and eosin. When indicated these same blocks were further treated by the paraffin method, sectioned and mounted after treatment with special stains. In all more than 300 sections were made available for study.

### CLINICAL DATA

*Incidence.* The gallbladder is by far the most common site of carcinoma of the biliary passages. It ranks about fifth in frequency of gastrointestinal malignant lesions and comprises about 5 per cent of all malignant lesions. In 33,500 operations on the biliary tract performed at the Mayo Clinic in the years 1907 to 1940, inclusive, there were 291 cases of primary carcinoma of the gallbladder, an incidence of 0.87 per cent. In seventy-seven (26.5 per cent) of these cases removal of the gallbladder or a large portion of the gallbladder was possible.

*Age.* Carcinoma of the gallbladder has been reported to occur most frequently in

the sixth decade of life; 45 per cent of our series of patients were in this decade of life. The youngest patient in the series was twenty-nine and the oldest was seventy-four years of age.

**Sex.** Almost invariably reports of carcinoma of the gallbladder indicate that women are affected more often than men. This observation is to be expected owing to the predominance of cholelithiasis in that sex. In our series there were sixty-one women and sixteen men, a ratio of approximately four women to each man.

**Stones.** The long history of colicky attacks of pain obtained in a large number of cases of carcinoma of the gallbladder (58.5 per cent of our series) favored the presence of stones as possible precursors of carcinoma in the gallbladder. MacCarty, in reviewing the pathologic material from 29,701 gallbladders removed surgically at the Mayo Clinic, found that the incidence of cholelithiasis varied directly with the degree of inflammation present. Although gallstones are not a specific cause of carcinoma, it does seem probable that repeated trauma and chronic irritation due to their presence may be a contributing factor. In 88 per cent of our cases stones were associated with the carcinoma. Much work has been done on the experimental production of carcinoma of the gallbladder but the results of those claiming successful accomplishment of this have been questionable.

**History Symptoms and Findings.** The past history, owing to the frequency of associated lithiasis, was in many cases of our series, one of previous colics. In a smaller group of cases the history consisted of a vague story of gaseous indigestion, intolerance to fatty and rich foods, and so forth. In about 80 per cent of our seventy-seven cases the past history was suggestive of a pathologic lesion in the gallbladder; the duration of the symptoms averaged 14.2 years. At the time of examination at the clinic the patients could be divided clinically into five rather distinct groups similar to those of Boyce

and McFetridge as follows: (1) thirty-six patients (46.8 per cent of the total) who had had colicky attacks for many years with superimposed symptoms suggestive of malignancy; (2) nine (11.7 per cent) who had had colicky attacks for many years without any recent change in symptoms; (3) thirteen (16.8 per cent) who gave a history of gaseous dyspepsia of long duration with superimposed symptoms suggestive of malignancy; (4) three (3.9 per cent) who gave a history of gaseous dyspepsia for a long time but did not report a recent change in symptoms and (5) sixteen (20.8 per cent) who had not had any symptoms referable to the gallbladder prior to the present illness. When overlapping occurred the case was considered in only one clinical group.

The phrase, "the symptoms are suggestive of malignancy," means that they are compatible with, but certainly not associated exclusively with a malignant process. The same symptoms are often associated with benign cholelithiasis.

Analysis of the early symptoms in our group of cases revealed nothing which could not be attributed to the presence of chronic inflammation of the gallbladder, with or without cholelithiasis. However, 80.3 per cent of the patients had noted a definite change in symptoms of relatively short duration. This change in the character of symptoms which had been present for an average of 14.2 years seemed to be a more important diagnostic factor than any particular clinical symptom in the early stages of the carcinoma.

In 71 per cent of the cases the present illness was of less than six months' duration; the average length was approximately four months. The present symptoms in order of frequency with which they were elicited were as follows: pain in 76 per cent of cases; loss of some weight in 67.5 per cent; dyspepsia in 27 per cent; weakness in 23.4 per cent; anorexia in 18 per cent; jaundice in 13 per cent; constipation in 11 per cent and nausea and vomiting in 10 per cent.

**Pain.** In approximately half of the cases in which pain was present the pain was colicky and in the remaining cases it was constant. The latter group includes a number of cases in which at the onset of the illness colicky pain had been present and a constant pain later developed. Patients who gave a past history of colicky attacks of pain frequently complained of some change in the attack such as increasing frequency and increasing severity or duration of the attacks of pain or one of these changes. The steady type of pain varied from an annoying mild ache (in seven cases) to a severe steady pain requiring sedation for relief. In most instances the pain was limited to the right upper quadrant of the abdomen but in some instances extended into the back and right shoulder and in one instance to the right groin.

**Loss of Weight.** In thirty-eight cases in which loss of weight was a presenting complaint the amount lost varied from ten to seventy pounds (4.5 to 31.8 kg.) and the duration of the complaint varied from three weeks to two years. The average loss was nineteen pounds (8.6 kg.). In four cases the only complaint of recent onset was that of loss of weight. That this can be associated with cholecystitis was shown by Deaver and Bortz; however, the percentage of patients who gave this complaint is decidedly smaller than that of patients who have early carcinoma of the gallbladder.

**Dyspepsia.** Gaseous dyspepsia, belching or flatulence were complained of in 27 per cent of our cases; this incidence is similar to that usually reported in cases of benign cholecytic disease. The dyspepsia was usually of recent onset and in most cases it had been present for less than seven months. In most instances the gaseous dyspepsia followed, within a short time, the ingestion of food.

**Other Symptoms.** Only brief comments will be made on the various other symptoms mentioned by the patients. Weakness was as a rule gradual in onset and in only two cases was it marked. The duration

of the complaint varied from ten days to one year. Anorexia was present in eighteen cases and in two additional cases there was marked intolerance to the ingestion of food. Jaundice was present in ten cases (13 per cent) and varied in duration from one day to five months. In two cases it was of the painless variety and was due to invasion of the common duct in one case and to pressure of a mass on the duct in the other. Nausea and vomiting had occurred in only eight cases and were marked in only one instance. Three patients reported feeling a mass in the abdomen for from three weeks to three months prior to examination. Constipation of recent onset was present in 11 per cent of the cases and in one case there was an intermittent diarrhea of three months' duration. Ascites which was present in one case was due to portal obstruction caused by a mass along the common duct.

**Physical and Laboratory Findings.** A tumor was palpable in 40 per cent of the cases; the largest tumor was the size of a grapefruit. In most instances the tumor proved to be a greatly distended gallbladder. In 23 per cent of cases the liver was palpable and in two instances it extended well below the umbilicus.

Tenderness over the right upper quadrant of the abdomen or in the epigastrium was found in more than half of the cases in this series and in one instance it was noted at McBurney's point.

In thirty-five of forty-four cases in which the leukocyte counts were recorded they were less than 10,000 per c.mm. of blood. The highest recorded count, namely 29,800, was recorded in the case of a woman, aged sixty-two years, who had a perforated gallbladder. In most instances an elevated count was associated with a recent attack of acute cholecystitis. The value of hemoglobin in thirty-two of forty-six cases in which it was recorded was greater than 75 per cent. The lowest value, 54 per cent, was that of a man, fifty-eight years of age, who had carcinomatous invasion of the liver. A low

fever was present in several cases. In no instance was the diagnosis of carcinoma made on roentgenoscopic examination.

#### PATHOLOGIC DATA

Gross studies of the entire gallbladder were made of sixty-five available specimens. In twenty-six cases (40.0 per cent) the gallbladder was distended to four times its normal size; in approximately a quarter of these cases empyema of the gallbladder was noted. In an additional eight cases (12.3 per cent) the gallbladders were enlarged and the wall markedly thickened. In seventeen cases (26.1 per cent) there was no appreciable enlargement of the gallbladder but the wall was found to be markedly thickened. An hourglass deformity was present in seven cases (10.8 per cent) and in an additional seven cases (10.8 per cent) a markedly thickened and contracted gallbladder was found.

Grossly, the mucosa in twelve cases showed papillary ingrowths. The site of the carcinoma was always represented by thickened mucosa wherever the wall of the gallbladder was involved. If the involvement was not too extensive, there was usually a rather sharp line of demarcation between the carcinoma and surrounding mucosa; this was not only visible but evident on palpation.

The site of origin of carcinoma of the gallbladder is commonly thought to be in the fundus; however, Judd and Gray did not find this to hold true. In our series a definite site was obtained in forty-eight of the cases. In 54 per cent of these cases the point of origin was in the region of the fundus; the origin in 27 per cent was the midportion and in 19 per cent the neck of the gallbladder.

The largest carcinoma encountered measured 7 by 5 by 6 cm. and the smallest was 2 mm. in diameter.

*Visible Metastasis or Direct Extension.* Visible metastasis or direct extension beyond the confines of the gallbladder was present in forty-eight (64 per cent) of the seventy-five cases in which these

factors were ascertained. In 28.2 per cent of the group in which metastasis or extension or both occurred metastasis alone was exhibited, in 43.6 per cent direct extension alone, and in 28.2 per cent both extension and metastasis. From this small series it would appear that direct extension occurs more often and earlier than metastasis; however, as the regional nodes were not routinely removed for biopsy the figure for metastasis may be low. Also it is likely that metastatic lesions too small to be visible were present in at least a few of the cases.

Sites of metastasis were as follows: liver in 73 per cent of cases; regional nodes in 61 per cent; pancreas in 15.3 per cent; omentum in 3.8 per cent and ovaries in 3.8 per cent. Sites of direct extension were the liver in 67.5 per cent of cases, ducts in 15.1 per cent, duodenum in 12.1 per cent, colon in 6.0 per cent, omentum in 3.0 per cent and abdominal wall in 3.0 per cent.

In 41.0 per cent of the seventy-five cases carcinomatous involvement of the liver had occurred and in 29.2 per cent carcinoma had involved the lymph nodes.

TABLE I  
METASTASIS ACCORDING TO GRADE OF LESION

Grade	Total Cases Studied*	Metastasis, Cases	Per Cent of Total Cases of Each Grade
1	20	4	25.0
2	25	16	64.0
3	18	16	88.8
4	12	12	100.0

\* Cases in which the carcinoma was of mixed grades are listed under the higher grade of lesion.

In seventeen cases the carcinoma was limited to the mucosa and submucosa without penetration through the muscularis. Sixteen of these were classified as grade 1 and one as mixed, grades 1 and 2. It appears from Table I that the frequency of spread beyond the confines of the gall-

bladder varies directly with the grade of the carcinoma.

Grossly, the carcinomas were evenly divided between the villous and the infiltrating types.

*Microscopic Findings.* In seventy-five cases in this series specimens were available which were suitable for microscopic examination. Sixty-four (85.3 per cent) of the carcinomas were of adenocarcinoma type. There were two cases of squamous cell carcinoma (2.7 per cent) and nine of mixed adenocarcinoma and squamous cell carcinoma (12.0 per cent), the so-called adeno-acanthoma.

TABLE II  
GRADE OF LESION IN 75 CASES

Type of Lesion	Grade	Cases	Per Cent of 75 Cases
Adenocarcinoma.....	1	20	26.7
	2	18	24.0
	3	8	10.7
	4	9	12.0
	mixed		
	1 and 3	6	8.0
	1 and 2	3	4.0
Adeno-acanthoma.....	1	0	
	2	2	2.7
	3	4	5.3
	4	3	4.0
Squamous cell carcinoma.....	2	2	2.7
All types.....	1	20	26.7
	2*	25	33.3
	3*	18	24.0
	4	12	16.0
	1 and 2	45	60.0

\* Cases in which the carcinoma was of mixed grades are listed under the higher grade of lesion.

Grading was done according to the method of Broders (Table II). In 60 per cent of the cases the carcinoma was of grade 1 or 2. As our series is a selected group this figure should not be taken as proof that carcinoma of the gallbladder is as a rule of low grade.

In three instances malignant change occurred in a pre-existing papilloma. This finding would indicate that papillomas have carcinomatous potentialities.

In one instance carcinoma, grade 1, was found to originate in an adenoma.

In a third of the adenocarcinomas signet ring cells were found. Usually little, if any, mucus was present and in only one instance was a sufficient amount present to warrant calling the carcinoma a mucous type.<sup>6</sup>

A mixture of grades was found in 21 per cent of cases. In every instance the difference between the grades was sufficiently marked to justify such a classification.

In four instances a definite squamous metaplasia was found to be present in the mucosa of a gallbladder in which adenocarcinoma was present. The finding of such regions is fairly conclusive evidence for the metaplasia theory of origin for squamous cell carcinoma. Further evidence is seen in the finding of mixed adenocarcinoma and squamous cell carcinoma (adeno-acanthoma) is 12 per cent of cases. Certainly it seems likely that the same cells may give rise to either an adenocarcinoma or a squamous cell carcinoma.

*Mode of Spread of the Carcinoma.* That carcinoma spreads locally by direct invasion and distally by way of the blood stream and lymph vessels and possibly, in rare instances, by implantation has long been established.

Perivascular spread of carcinoma was present in twelve (16.0 per cent) of the seventy-five cases. In these cases the involvement was definitely primary, as distinguished from secondary involvement. By secondary perivascular involvement is meant that the vessel is surrounded by a mass of carcinoma which does not show any definite tendency to be localized to the perivascular space.

Intravascular involvement was found in 17.3 per cent of cases. Recently, attention has been focused on the dissemination of carcinoma cells along the perineural lymphatic spaces. Kahler found perineural spread in practically all cases of carcinoma of the prostate. Ewing mentioned spread of carcinoma of the gallbladder along the nerve sheaths. In this series such a mode of

dissemination was found in 22.7 per cent of the lesions. Invasion of the nerve proper was present in 5.3 per cent of specimens.

TABLE III  
TYPE OF SPREAD

Grade	Perinural	Intra-neurial	Peri-vascular	Intra-vascular
1	4	0	0	0
2	5	2	3	4
3	7	2	6	7
4	1	0	3	2

In Table III is given the number of cases of each grade in which these methods of spread occurred. As would be expected the incidence of spread via the routes listed in Table III varied directly with the grade of the carcinoma. In carcinoma, grade 4, the involvement was usually too extensive to permit an accurate determination of the mode of spread; in most cases the spread fell into the so-called secondary classification.

TABLE IV  
SUMMARY OF MICROSCOPIC OBSERVATIONS ON MUCOSA OF THE GALLBLADDER IN 65 CASES

Observations	Cases	Per Cent
Increased lymphocyte infiltration		
Minimal.....	4	
Moderate.....	50	100
Marked.....	11	
Fibrosis		
Minimal.....	18	
Moderate.....	27	100
Marked.....	20	
Rokitansky-Aschoff sinuses.....	33	50.8
Infiltration with plasma cells.....	28	43.1
Infiltration with polymorphonuclear leukocytes.....	5	7.7
Hemorrhage.....	7	10.8
Necrosis.....	7	10.8

*Microscopic Study of the Mucosa of the Gallbladder.* The criteria set forth by MacCarty for pathologic changes in the gallbladder were used as a basis in this study. Specimens of mucosa were available in sixty-five cases (84.4 per cent of the total

number of cases in the series). It can be seen from Table IV that in each case pathologic changes were exhibited in the gallbladder remote from the carcinoma. In most instances these changes were rather marked. The diagnoses made from observations on the mucosa are given in Table V.

TABLE V  
DIAGNOSIS MADE FROM OBSERVATIONS ON MUCOSA

Diagnosis	Cases	Per Cent
Chronic catarrhal cholecystitis.....	1	1.5
Chronic cholecystitis.....	24	36.9
Acute or chronic cholecystitis.....	12	18.5
Subacute or chronic cholecystitis.....	28	43.1
Total.....	65	100.0

It can be stated from the observations listed in Table V that carcinoma of the gallbladder never arises in a normal mucosa. In spite of the high incidence of cholecytic diseases found in routine postmortem specimens (75.5 per cent reported by Mentzer and 58.4 per cent reported by Crump) carcinoma of the gallbladder is found in only 0.3 to 0.4 per cent<sup>7</sup> of routine postmortem specimens.

#### CORRELATION OF SYMPTOMS WITH PATHOLOGIC CHANGES

An attempt was made to correlate the two chief symptoms, namely, pain and loss of weight, with the extent of the carcinoma.

TABLE VI  
GRADE AND EXTENSION OF CARCINOMA IN 52 CASES IN WHICH PAIN WAS A PRESENTING COMPLAINT

Grade	Carcinoma, Cases			Per Cent of Total Cases of Each Grade in Entire Series*
	Localized to Gallbladder	Not Localized to Gallbladder	Total	
1	7	3	10	50.8
2	5	14	19	76.0
3	2	13	15	83.3
4	0	8	8	66.7

\* Total number of cases of carcinoma of each grade is given in tables I and 2.

In fifty-nine cases a presenting complaint was pain, however, in seven cases this pain was mild. These seven cases were eliminated in this correlation. In Table VI fifty-two cases in which pain was a presenting symptom are grouped according to extension of the carcinoma. Thus in thirty-eight (73.1 per cent) of the fifty-two cases in which pain was one of the presenting complaints the carcinoma had extended beyond the confines of the gallbladder.

TABLE VII  
GRADE AND EXTENSION OF CARCINOMA IN 38 CASES IN WHICH LOSS OF WEIGHT WAS A PRESENTING COMPLAINT

Grade	Carcinoma, Cases		Per Cent of Total Cases of Each Grade in Entire Series*
	Localized to Gallbladder	Not Localized to Gallbladder	
1	8	2	50.0
2	2	11	52.0
3	1	10	61.1
4	0	4	33.3

\*Total number of cases of carcinoma of each grade is given in tables 1 and 2.

The cases in which recent loss of weight occurred are grouped according to extension of the carcinoma in Table VII. Thus in twenty-seven (71.1 per cent) of the cases in which recent loss of weight occurred the carcinoma had spread beyond the gallbladder. It also was found that in 50 per cent of the cases of carcinoma, grade 1,

recent pain or loss of weight had not occurred. In only one case of carcinoma of each of the other three grades were both of these symptoms lacking. Six patients who had adenocarcinoma, grade 1, which was limited to the mucosa had lost from fifteen to fifty pounds (6.8 to 22.7 kg.) within a year; two complained of a constant pain in the right upper quadrant.

#### PROGNOSIS

An attempt was made to determine for each grade of malignancy the average length of survival following operation of patients dying from recurrence of the carcinoma and for those who were still living. Nine patients died within two to twelve days following operation and were not included in the statistics. Also excluded were two who had been operated upon for adenocarcinoma, grade 1, within the last six months of 1940 and six patients who died from causes other than the carcinoma. Three of these last patients had carcinoma, grade 1, two grade 2, and one grade 4. The period of survival according to grade of the carcinoma is fifty-four cases in which follow-up data were available is given in Table VIII. It is interesting that the period of survival in cases of carcinoma, grade 1, was four times that in cases of carcinoma, grade 2. Seven patients who had adenocarcinoma, grade 1, have survived five years or more after the operation. Four of these have survived more than thirteen years. Only one patient

TABLE VIII  
SURVIVAL AFTER OPERATION IN 54 CASES IN WHICH FOLLOW-UP DATA WERE AVAILABLE  
Period of Survival after Operation

Grade	Cases	Period								
		1-3 Mo.	3-6 Mo.	6-12 Mo.	12-18 Mo.	2 Yr.	3 Yr.	4 Yr.	5 Yr.	Average Mo.
1	13	1	0	1	2	1	1	..	7	78.0
2	17	1	6	3	2	1	2	1	1	18.9
3	13	4	2	3	4	..	..	..	..	6.4
4	11	2	6	2	1	..	..	..	..	5.1

who had carcinoma, grade 2, has survived five years and that patient is alive six years following operation. It is also of interest that one patient with adenocarcinoma, grade 4, of the gallbladder survived for a period of eighteen months following operation. The longest survival of a patient who had carcinoma, grade 1, was twenty-eight and a half years. Of the three patients who had carcinoma, grade 1, and died of causes other than the carcinoma two lived more than five years thus bringing the figure up to nine instead of seven. Thus 45 per cent of the patients who had carcinoma, grade 1, survived five or more years while only one (4.3 per cent) of the patients with carcinoma, grade 2, and not one of those with carcinoma, grades 3 and 4, survived five years. Therefore, it can be stated that adenocarcinoma, grade 1, of the gallbladder, when limited to the mucosa and submucosa has a good chance for a cure. In our series three patients who had adenocarcinoma, grade 1, with invasion of all layers of the gallbladder or metastasis to surrounding structures survived operation by an average of only 7.3 months.

The great difficulty in diagnosing carcinoma of the gallbladder is evidenced by the fact that in no instance was a definite diagnosis made preoperatively.

#### SUMMARY

Carcinoma of the gallbladder occurs most frequently in the fifth decade of life and is predominantly a disease of women. Stones were associated with the carcinoma in 88 per cent of cases and that they definitely preceded the development of the carcinoma was evident in 58.5 per cent of these cases. An analysis of the early symptoms revealed nothing which could not be attributed to the presence of chronic inflammation of the gallbladder with or without cholelithiasis.

The classification of these carcinomas was adenocarcinoma, 85.3 per cent; squamous cell carcinoma, 2.7 per cent, and adeno-carcinoma, 12.0 per cent. Three instances of malignant degeneration in a papilloma and one in an adenoma were found. The finding of areas of metaplasia in the mucosa and of adenocarcinoma and squamous cell carcinoma in the same tumor lends support to the theory of metaplasia for the origin of a squamous cell carcinoma.

Five-year cures were obtained in 45 per cent of the cases of carcinoma, grade 1, in 4.3 per cent in cases of grade 2 and in none of the cases of carcinoma of the other grades. In no instance was a definite diagnosis made preoperatively.

#### REFERENCES

1. BOYCE, F. F. and MCFETRIDGE, E. N. Carcinoma of the gallbladder; critique based on analysis of 25 cases from Charity Hospital in New Orleans. *Internat. S. Digest.*, 21: 67-79, 1936.
2. COOPER, W. A. Carcinoma of the gallbladder. *Arch. Surg.*, 35: 431-448, 1937.
3. CRUMP, CURTIS. The incidence of gall stones and gall-bladder disease. *Surg., Gynec. & Obst.*, 53: 447-455, 1931.
4. DEAVER, J. B. and BORTZ, E. L. Gallbladder disease, a review of nine hundred and three cases. *J. A. M. A.*, 88: 619-623, 1927.
5. EWING, JAMES. Neoplastic Diseases; a Treatise on Tumors. Ed. 4, Pp. 1160. Philadelphia, 1940. W. B. Saunders Company.
6. GRANT, RUSSELL. Mucous carcinoma of the stomach. Thesis, 35 pp. Graduate School of the University of Minnesota, 1941.
7. ILLINGWORTH, C. F. W. Carcinoma of the gall-bladder. *Brit. J. Surg.*, 23: 4-18, 1935.
8. JUDD, E. S. and GRAY, H. K. Carcinoma of the gallbladder and bile ducts. *Surg., Gynec. & Obst.*, 55: 308-315, 1932.
9. KAHLER, J. E. Carcinoma of the prostate (a pathologic study). Thesis, 79 pp. Graduate School of the University of Minnesota, 1937.
10. MACCARTY, W. C. The Pathology of Gallbladder Disease. In Walters, Waltman and Snell, A. M.: Diseases of the Gallbladder and Bile Ducts. Pp. 77-94. Philadelphia, 1940. W. B. Saunders Company.
11. MENTZER, S. M. A clinical and pathologic study of cholecystitis and cholelithiasis. *Surg., Gynec. & Obst.*, 42: 782-793, 1926.
12. STOLT, MAXIMILIAN. Quoted by Cooper, W. A.



# MANAGEMENT OF THE EXTERNAL BILIARY FISTULA\*

R. RUSSELL BEST, M.D.

Associate Professor of Surgery, University of Nebraska College of Medicine

OMAHA, NEBRASKA

FOR simplicity, biliary tract fistulas may be divided into two types: mucobiliary fistulas and bile-biliary fistulas. Both are true biliary fistulas in that they communicate with some part of the biliary tract. Not too infrequently, one sees a right upper quadrant fistula which has drained for weeks, months or even years without satisfactory explanation because the problem has not been sufficiently investigated.

Mucobiliary fistulas are those in which there is persistent drainage from the gallbladder following cholecystostomy, incomplete removal of the gallbladder, or spontaneous exterior rupture of the gallbladder. In this type of fistula, the cystic duct is obstructed and the secretion from the mucous pouch or gallbladder must find another means of exit. The story is usually characteristic in that the drainage tract closes, then some weeks later pain, swelling and tenderness develop, to be followed in a few days by release of mucus or mucopurulent fluid. This process may repeat itself again and again. The occasional presence of bile in this fluid may be explained by the valvular action of the cystic duct or neck of the gallbladder which permits a small amount of bile to enter the gallbladder but does not permit it to exit freely through the cystic duct. Again, a small anomalous duct may lead directly from the liver into the gallbladder. Unless an internal communication develops to permit drainage or the secreting mucosal wall is destroyed, the repetition will continue. Although one can sometimes reason out the mechanical problem in such a case and then proceed to correct it by proper removal of the gallbladder, it is far better to visualize<sup>1,4</sup> the mechanical and pathologic problem by injecting a radiopaque

substance such as 40 per cent hippuran or diodrast into the fistulous tract. Usually, some obstructive agent such as stone, mucous plug, blood clot, organized débris, or possibly stricture will be found occluding the cystic duct. The cystic duct obstruction was released in two instances by repeated irrigations with normal saline and warm olive oil in conjunction with antispasmodics by mouth. In one case, 1/20 gr. of atropine dissolved in a little warm water was instilled into the tract in the hope that it might aid in relaxing the musculature of the neck of the gallbladder and cystic duct. Although the obstruction was released, the part played by the atropine solution cannot be estimated. On two occasions, Pribham's<sup>5</sup> method of instilling 5 cc. of a mixture of  $\frac{2}{3}$  ethyl ether and  $\frac{1}{3}$  ethyl alcohol was not successful in disintegrating the stone within the cystic duct, but this method should be borne in mind.

Cholecystoscopy, which Hollenberg and Eikner<sup>6</sup> accomplished by passing a cystoscope through the drainage tract, is certainly an ingenious procedure and is occasionally indicated. In one instance, I substituted an infant size proctoscope by enlarging the drainage tract slightly and injecting a little air, but could see nothing to be removed. If the cholecystogram reveals a stone and a patent cystic duct in a patient who has declined operation or is a poor operative risk, this stone, which frequently acts as an undesirable, foreign free body, could be removed by cholecystoscopy. However, in most instances cholecystectomy with or without exploration of the common duct becomes necessary.

The bile-biliary fistula is usually a sequel of some operative procedure upon the gallbladder. It frequently follows a cholecys-

\* From the Department of Surgery, University of Nebraska College of Medicine.

tectomy during which the common duct has been injured, or more frequently when there is a remaining stone, tumor, blood clot, mucous plug or organized débris obstructing the common duct.<sup>1,2</sup> At other times, spastic biliary dyssynergia<sup>4</sup> may obstruct the flow of bile and produce sufficient back pressure to break through the ligated cystic duct. Again, the ligature may slip off the cystic duct and even though the common duct is not completely obstructed, there may be enough resistance that the bile finds easier egress through the drainage tract.

If bile drainage begins several days after operation, is rather profuse at first and then gradually diminishes and ceases, the ligature on the cystic duct has probably failed in its purpose by cutting through, absorbing too early, or coming loose. If bile flow is profuse and continuous, common duct injury or some obstructing agent in the common duct should be suspected. When profuse drainage persists after removal of the common duct T-tube or catheter, there is usually some obstruction in the duct such as a stone, tumor or cholangial spasm. Under no circumstances, therefore, should a T-tube or catheter be removed before a delayed cholangiogram has been obtained, but since this is occasionally done, the subject will be discussed.

After drainage has persisted for a week or ten days without much decrease, a delayed cholangiogram should be made by injecting about 30 cc. of 40 per cent hippuran or diodrast solution into the sinus tract. Either the syringe tip or the inserted rubber catheter is held in such a manner that the opaque medium cannot return. An x-ray is taken immediately and repeated in ten minutes, keeping the fistulous tract blocked with a gauze pack during the interval. Following this, some of the contrast medium should be allowed to escape from the tract and another x-ray taken ten minutes later. The first ten-minute interval with the external exit blocked permits the contrast medium to escape under the existing pressure into the duodenum, if possible.

The second ten-minute interval with the external exit open, permits some of the contrast medium to escape externally, and possibly because the opaque medium is then less dense, a stone or some other obstructive factor may be seen which was previously obscured by the excess contrast medium. Under no circumstances should a final conclusion be drawn regarding the status of any biliary fistula until a cholangiogram has been made.

A biliary fistula occurs because the resistance in the common duct or sphincter area is greater than that of the drainage tract or operative wound. The bile takes the course of least resistance and continues to flow through the abnormal tract to the outside until the obstructive factor has been removed. If the cholangiogram reveals only spasm at the lower end of the common duct (so-called spastic dyssynergia), attention should be directed toward relaxing the sphincter area. In such instances it is advisable to place the patient on the same three-day biliary flush that is used for the removal of remaining common duct stones,<sup>1,5</sup> because it uses to advantage most of the agents which relax the sphincter area and tends also to flush out any small foreign bodies that might be a source of irritation to the sphincter area. Following is the outline of this flush regime:

1. 3 decholin or procholon tablets after each meal and at bedtime for 3 days
2. 2 drams of magnesium sulfate each morning
3. 1 ounce of pure cream or olive oil before noon and evening meals and at bedtime
4. First day:  $\frac{1}{100}$  gr. nitroglycerin tablet dissolved under the tongue three times a day before meals
5. Second day:  $\frac{1}{100}$  gr. atropine tablet in water three times a day before meals
6. Third day:  $\frac{1}{100}$  gr. nitroglycerin as on first day
7. The fistula should be irrigated gently each day with warm normal saline solution and after this has completely drained off, 10 to 30 cc. of warm sterile olive oil instilled
8. The fistula should be packed during treatment except for one hour out of six unless

the patient complains of severe pain in which case the pack may be removed for a short time

9. Intravenous decholin sodium may be substituted for the oral method, using one 10 cc. ampule of 20 per cent solution

In a number of instances, the biliary fistula has closed after one or two of these flushes and remained closed without any untoward effects. When spasm appears to be the factor, it is most important to instill warm olive oil for several days, and on at least one occasion to instill a warm iodized oil such as lipoiodine or lipiodol as the latter seem to exert a definite healing and soothing effect. On one occasion, this spastic condition persisted for thirty days, so completely obstructing the flow of bile that the stools were clay colored until finally the instillation of warm iodized oil brought immediate complete relaxation and the patient had no further difficulty.

Should the cholangiogram reveal a foreign body in the common duct, it is doubtful whether the fistula will ever close permanently until the obstructing agent has been removed. The patient should be given the three-day biliary flush, during which time the fistula should be plugged with gauze except for several one-hour periods each day. Releasing bile from the duct for a few hours each day prevents too much back pressure against the hepatic cells with its possible subsequent injury. If the patient experiences a great deal of pain, the packing should be released more frequently during the day. Warm olive oil, warm normal saline, or both, should be instilled into the fistulous tract under pressure each morning. Having the patient dissolve a  $\frac{1}{100}$  gr. tablet of nitroglycerin under his tongue just before the irrigation is started, may relax the sphincter area sufficiently to permit better through-and-through irrigation into the duodenum. If the cholangiogram shows the foreign body has not been dislodged after the flush, the patient should be permitted to rest for three days and then the flush should be repeated. In this second flush, intravenous decholin sodium is substituted for the

decholin or procholon by mouth, using 10 cc. of a 20 per cent solution each day for three days. There appear to be definite advantages in using this hydrocholeretic in conjunction with the antispasmodics when the oral method has failed to dislodge a foreign body. If the stone is too large to pass through the sphincter area, it cannot be satisfactorily dislodged; but it is interesting to note that although small stones are more apt to be flushed out, there have been cases in which a very small stone or stones could not be dislodged, whereas in other cases stones  $1\frac{1}{2}$  cm. in diameter have been recovered from the stool. However, the larger the stone, the greater the difficulty, and also the greater the chance of failure. In one instance, repeated flushes failed to dislodge a small stone from the common duct, a secondary operation was consequently performed and the stone was found frozen to the mucous membrane of the duct. Only with considerable effort could it be removed.

If the flush does not dislodge the obstructing agent, Pribham's<sup>8</sup> solvent or fragmentation method should be tried, instilling about 5 cc. of a mixture of  $\frac{1}{3}$  ethyl alcohol and  $\frac{2}{3}$  ethyl ether in the hope of disintegrating the stone into smaller fragments that can be washed out with the biliary flush. In twelve attempts with this method, however, I have been successful on only one occasion, even though increasing the amount of solution to 10 cc. at times. Walters<sup>10</sup> reports a successful attempt, and Raffl<sup>9</sup> in a recent article refers to the successful disruption of a common duct stone with pure ether. He also carried out some interesting experiments on animals, proving that many times the process is slow and requires daily instillations for four or five days. He states that provision should always be made for immediate release of the greatly increased intraductal pressure. This can be accomplished very simply in most cases by permitting the plunger to come back into the syringe or by removing the syringe for a few seconds from the fistulous opening or catheter. The amount of pain

the patient experiences is somewhat indicative of the degree of newly built up intra-ductal and intrahepatic pressure. Raffl suggests that if possible a second small catheter be used to furnish an outlet for gas. He is of the opinion that liver injury does not occur under ordinary precautions and proved there was very little reaction in the cells of the gallbladder, ducts or liver under proper care. The recent work of H. L. Baker, although not germane to the subject of biliary fistula, is of interest in the discussion of ether or ether-alcohol instillations, for he describes a T-tube which could well be used in all common duct operations. The tube has an angle of 45 degrees rather than the usual 90 degrees. A smaller catheter can be passed through it into the duct so the ether can be released directly onto the stone and the gas can escape around the smaller catheter.

On one occasion, I was consulted about a biliary fistula because the cholangiogram revealed a markedly atonic common duct sphincter that permitted a large quantity of digestive juices to enter the duct. This so severely digested the surrounding skin that only by inserting a catheter into the tract and attaching a small electric suction pump could any progress be made in healing the tissues so the fistulous tract could close.

If the common duct is so completely obstructed that no bile, or at the most only a small amount, is reaching the gastrointestinal tract, vitamin K and bile salts should be given by mouth to build up the anti-hemorrhagic factors; for the hypo-prothrombin is just as marked in persons with biliary fistulas as in severely jaundiced individuals. For some time, I have been using synkamin, a synthetic substance highly potent in vitamin K activity. This can be given intravenously (1 mg. ampule) two or three times a day and usually within forty-eight hours the prothrombin bleeding time is normal. Given orally, this particular water-soluble vitamin K product does not require the co-administration of bile salts to be effective, but it is my belief

that the digestive processes of both the jaundiced individual and the individual with a complete biliary fistula will function better if some form of bile is administered several times daily. One or two 2 mg. capsules are given orally several times a day. The fluid intake should also be closely observed in relation to the abnormal loss through bile drainage. Emphasis must be placed on glucose and protein intake to support liver function.

After all non-operative measures for re-establishing the normal flow of bile into the duodenum have failed, surgery is usually indicated. If the gallbladder is present and cystic duct obstruction is the source of difficulty, cholecystectomy gives most satisfactory results. The common duct should be opened when the patient has been jaundiced, if small stones were present in the gallbladder at the first operation, or when the duct is dilated or its wall thickened. If the cystic duct is patent, a common duct stone has probably been revealed by the cholangiogram, and routine choledochostomy should be carried out with removal of the gallbladder. If, by cholangiography, a tumor such as carcinoma of the duct, papilla, pancreas or duodenum has been found obstructing the lower end of the common duct and this is verified at operation, the Whipple<sup>11</sup> procedure or its modification for resection of the lower end of the common duct, pancreas and duodenum is indicated. An inoperable lesion requires cholecystogastrostomy or cholecystoduodenostomy. If the gallbladder has been removed, choledochoduodenostomy, choledochogastrostomy or choledochojejunostomy is indicated. In all cases of cholecystoenterostomy, no matter which type, the patient should be instructed to take a partial biliary flush the first three days of each month, taking only the decholin or procholon tablets (dehydrocholic acid products), three  $3\frac{1}{4}$  gr. tablets before each meal and at bedtime, and omitting the nitroglycerin, atropine, cream and magnesium sulfate. The increased flow of thin, watery bile under heightened pressure af-

fords a definite flushing effect. Since adopting this program, the incidence of chills and fever, indigestion and abdominal distress has so markedly decreased that I am convinced of its definite value. In one instance, the oral method did not quiet down an attack of partial jaundice with its accompanying distress, chills and fever, and 10 cc. of the 20 per cent solution of decholin sodium were given intravenously for three days. This immediately relieved the condition and after taking the oral flush each month for one year, the patient has had no recurrence of symptoms. Just two months ago, she underwent an abdominal hysterectomy and made a very smooth convalescence. There was no opportunity to explore the right upper quadrant at this time because of the low midline incision.

The common duct region is approached by an upper right rectus incision. If a small rubber catheter can be inserted into the fistulous tract to a depth sufficient to reach the common duct, it may be used as a guide in locating the duct. If a catheter cannot be passed, the fistulous tract may be plugged the evening before operation, and the dilated common duct more easily identified at the operating table. In any event, before incising the common duct with the sharp pointed No. 11 Bard Parker blade, the duct should be definitely identified by withdrawing bile through a one-inch No. 22 gauge needle on a 10 cc. syringe. After incision, the stone or stones are removed and a T-tube inserted. If there is any doubt as to whether all of the stones have been removed, a cholangiogram may be taken before closing the abdomen. Under no circumstances should the T-tube be removed before a cholangiogram is taken about seven to ten days following operation. It is my conviction that the end results are better if the three-day biliary flush is prescribed following the removal of any T-tube, to wash out remaining débris and exudate. During the last three years, this has become routine.

A biliary fistula should always arouse suspicion of partial to complete obliteration

of the common duct by stricture secondary to injury of the duct. Here again a cholangiogram makes the diagnosis much less difficult. Occasionally, the common or hepatic duct may be completely severed in the course of routine cholecystectomy. If the stricture causes total exclusion of bile from the intestinal tract, the results are disturbance of digestion, disturbance of body chemistry, marked tendency to hemorrhage, loss of weight and strength, and ultimately a condition of osteoporosis. Unless counteractive measures are taken, the condition terminates fatally. It must be kept in mind that a patient with a complete biliary fistula is in just as precarious a condition as a jaundiced individual. With stricture, it has been the usual experience of most surgeons that a local plastic operation is not satisfactory and some type of cholecystoenterostomy as previously mentioned is indicated. At times, reconstruction of the duct over a T-tube will give excellent results. Lately Pearse<sup>7</sup> has made an encouraging report on the use of the vitallium tube in the common duct.

#### SUMMARY

1. A satisfactory diagnosis cannot be made in cases of biliary fistula until a cholangiogram has been obtained; there can be only suspicion and speculation.
2. The biliary flush by the oral or intravenous method may be of definite value in dislodging obstructing agents or releasing biliary spasm.
3. Ether and alcohol mixture for fragmentation of stones is effective in a few cases.
4. The same measures used to counteract the disturbed physiology in jaundice cases are necessary in cases of complete biliary fistula.
5. Many cases of biliary fistula demand surgery.
6. All cases of biliary intestinal anastomosis should receive the biliary flush once each month.

#### REFERENCES

1. Best, R. R. Cholangiography demonstration of the remaining common duct stone and its nonopera-

- tive management. *Surg., Gynec. & Obst.*, 66: 1040, 1938.
2. BEST, R. R. Management of common duct lesions. *Nebraska M. J.*, 26: 5, 1941.
  3. BEST, R. R. The acute gallbladder. *Surg., Gynec. & Obst.*, 73: 312, 1941.
  4. BEST, R. R. and HICKEN, N. F. Biliary dysynergia: physiological obstruction of common bile duct. *Surg., Gynec. & Obst.*, 61: 721, 1935.
  5. BEST, R. R., HICKEN, N. F. and FINLAYSON, A. I. The effect of dehydrocholic acid upon biliary pressure and its clinical application. *Ann. Surg.*, 110: 67, 1939.
  6. HOLLOWBERG, H. G. and EIKNER, W. C. Cholecystoscopy. *Surgery*, 2: 37, 1937.
  7. PEARSE, H. E. Vitallium tubes in biliary surgery. *Ann. Surg.*, 115: 1031, 1942.
  8. PRIBHAM, B. O. New methods in gallstone surgery. *Surg., Gynec. & Obst.*, 60: 55, 1935.
  9. RAFFL, A. B. Experimental studies on solvent action of ether on gallstones. *Am. J. Surg.*, 52: 65, 1941.
  10. WALTERS, W. and WESSON, H. R. Fragmentation and expulsion of common duct stone into the duodenum by using ether and amyl nitrite. *Surg., Gynec. & Obst.*, 65: 695, 1937.
  11. WHIPPLE, A. O. Surgical treatment of cancer of the ampullary region and head of the pancreas. *Am. J. Surg.*, 40: 260, 1938.



THE vulva is exceedingly rare as the seat of a primary sarcoma; this is somewhat more often seen as a malignant change in fibroma or nevus.

# IMPROVED TECHNIC FOR THE CLOSURE OF A LOOP COLOSTOMY\*

JOHN WILLIAM HOWSER, M.D.

Associate Attending Surgeon, Cook County Hospital

CHICAGO, ILLINOIS

AS pointed out by Ochsner<sup>1</sup> as well as other observers, fatalities following resections of portions of the gastrointestinal tract are due primarily to peritonitis. It is true that the number and virulence of the micro-organisms increase directly as the distance from the oral end of the tract. Thus it follows that peritonitis and fatalities would be expected to be more frequent in resections of the large bowel as compared with the small bowel. That this is the case is shown by Shambaugh<sup>2</sup> who noted that in a series of necropsies the incidence of peritonitis was 15.3 per cent in thirty-nine cases in which operations had been performed on the stomach and small bowel, whereas in a group of fifty-two cases in which operations had been done on the large bowel, there was peritonitis present in 33 per cent. There is to be expected a certain minimal mortality in extensive resections of portions of the large bowel. The patient has a severe lesion usually, and in many instances if the lesion were not resected, it would ultimately kill the patient.

Devine<sup>3</sup> has done much to advance the safe resection of segments of the large bowel through the technic of the "de-functionalizing" colostomy.

Prior to the advent of the sulfonamide group of drugs, primary resection and anastomosis of portions of the colon carried a considerable mortality. Even today the intra-abdominal resection and anastomosis of the large bowel is a serious operation, attended by some deaths. Stage operations, in which agglutination between the parietal and visceral peritoneum are used to wall

off the area, have found favor in many hands. The Heinecke-Mikulicz and the Lahey-Mikulicz technics are examples of this type of resection.

There have been many ingenious operations conceived in order to make more safe the opening of the gastrointestinal tract within the abdomen without contamination, or creating a fistulous tract to the outside without intra-abdominal soilage. Glassman<sup>5</sup> has done this type of an operation in creating a gastrostomy, and McNealy<sup>4</sup> has done the same in developing his cecostomy. The numerous two-stage types of operations for opening intra-hepatic and subphrenic abscesses are examples of the same principle.

For a number of years, the performance of a colostomy consisted essentially of bringing a loop of colon to the outside of the abdomen. These "colostomies in continuity" were then transected, and a rather permanent type of double stomas were left. These were either side to side, in the event that a glass rod or similar structure was used, or they were separated by a portion of the entire abdominal wall. These colostomies were intended for the most part to be permanent colostomies, done usually for an inoperable carcinoma of the bowel distal to that site. If the entire abdominal wall was brought under the loop, hence between the resultant stomas, the technic was a modification of the Mixter type.<sup>6</sup>

Some of these colostomies result from "exteriorization" procedures in which a loop of gangrenous bowel is brought to the surface, and because of the condition

\* From the Department of Surgery, Loyola University Medical School, Cook County Hospital, Chicago, Illinois, and the West Suburban Hospital, Oak Park, Illinois.

of the patient no other procedure is done at that time. Also, some of these colostomies have been done prior to reconstruc-

which has little or no danger attached to it. This view is held also by many members of the medical profession who do not do any surgery and also by many lay people. It is then particularly distressing to have such a patient develop peritonitis and die from such an operation.

In the event that the mesentery of the colon has been brought to the skin surface, as is the usual case, the closure of this type of a colostomy is a formidable procedure. It represents at best an extraperitoneal end-to-end anastomosis of the colon. There are very few of these, however, that can be done extraperitoneally. It is far more common to have to open up the abdomen to get enough bowel to bring the two ends together satisfactorily. One hears that because of the long standing spillage of feces onto the abdominal wall during the time the colostomy has been functioning, it will vaccinate the patient against his own intra-colonic organisms, and that intra-abdominal contamination need not be feared. Also, because of the sulfonamide drugs being so available, it is possible to follow such procedures and then deposit some of these drugs near the anastomosis and have healing and no peritonitis. I believe that these factors are of considerable importance, but I do not believe that either of them should be considered an excuse for open intra-abdominal closure of a loop colostomy. To depend upon these factors in an elective operation, undertaken only for the patient's convenience, seems to be taking a considerable risk.

There is no doubt that the procedure advocated by Pauchet<sup>7</sup> makes a nice plastic closure of these colostomies, and other methods can be used in the open intra-abdominal closure, but fatalities do and have been occurring after such closures.

I have recently utilized a method of closing colostomies of this type with excellent results. I submit it not with any feeling that it is entirely original, as it utilized the principles of Heinecke,<sup>8</sup> Mikulicz,<sup>9</sup> Paul,<sup>10</sup> and more lately of Devine.<sup>11</sup> However, it has some degree of originality

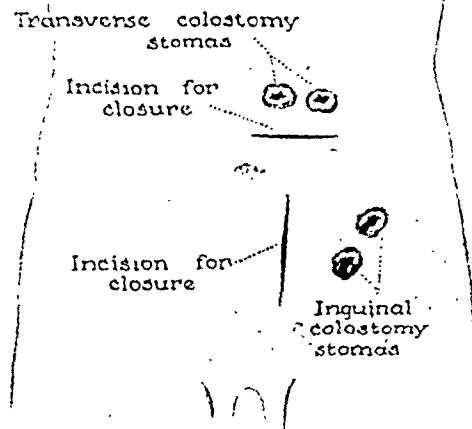


FIG. 1. Incisions used in closure of loop type colostomy.

tion of the immature or absent genitalia in infants. There is also a group that are done on inflammatory lesions which at the time of exploration are deemed to be carcinoma and because of their position or attachment are thought to be unresectable. As Devine<sup>3</sup> has shown, complete side tracking of the intestinal contents, with resultant rest to the affected segment, as surely occurs after transection of a loop type colostomy, may allow the distal inflammatory lesion to heal.

There is then a certain small group of patients who have had a loop type colostomy done, who later wish these colostomies to be closed. Many, of course, done for far advanced carcinoma will never need such closure.

The patient in whom this closure is indicated is ordinarily a well developed, rehabilitated patient, who considers the closure an elective or a plastic procedure

in the order in which these principles are carried out.

It has been my fortune in the past several

no leakage of the suture line; the peritonitis was due to the implantation of infection at the time of operation.

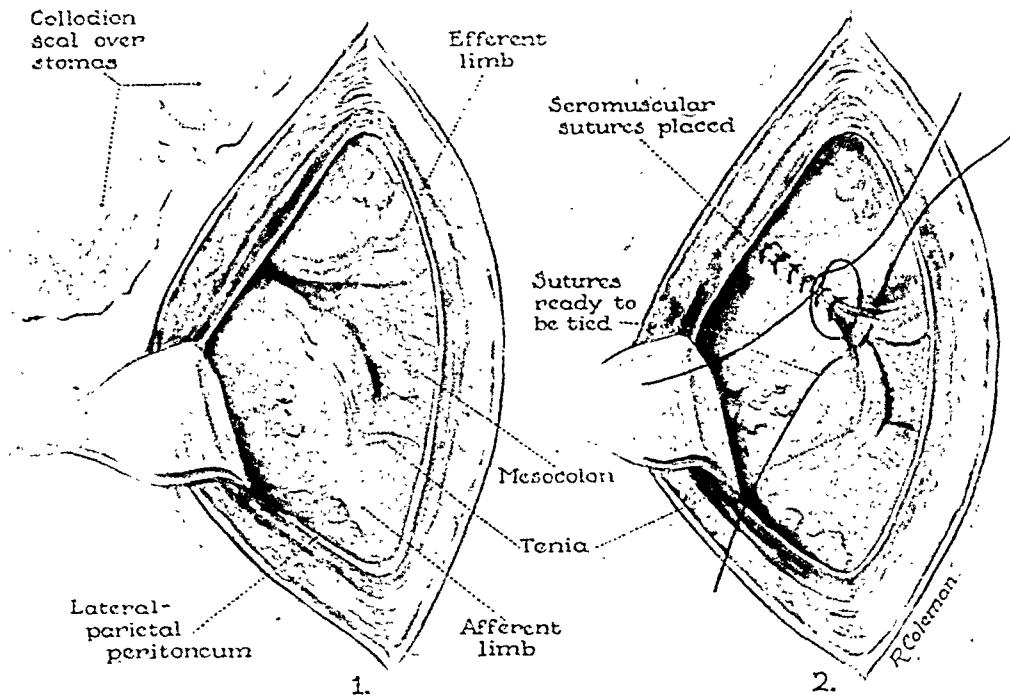


FIG. 2. Intra-abdominal steps in closure of loop type colostomy. 1, Shows appearance upon opening abdomen with visualization of the afferent and efferent limbs. 2, Shows the seromuscular, interrupted sutures placed along the tenia of the two limbs paralleling the limbs.

months to have been confronted with three such loop colostomies which I wished to close. One had had the Mixter type of procedure done, in which the abdominal wall was entirely separating the two stomas; this had been done for a perforated diverticulum of the sigmoid. The other two had only peritoneum and fascia closed between the two stomas. The problem is the same.

I utilized the usual procedure, somewhat after the method of Pauchet<sup>7</sup> for the first of these cases. The skin was freed, the abdominal wall incised, the peritoneum opened by intention, the two limbs identified, and closed with two rows of interrupted silk sutures. Sulfanilamide was placed in the abdomen and the wound closed. On the fourth day postoperatively the patient died, autopsy showing a diffuse peritonitis as the cause of death. There was

In the next two cases, I utilized the method to be described with only minimal discomfort to the patients and complete satisfaction in regard to closure of the stomas.

#### METHOD OF CLOSURE

In this method of closure the essential steps are as follows: The colostomy stomas are cleansed, the two limbs irrigated prior to operation, and the stomas closed with waterproof adhesive, and sealed around the edges with collodion. They are left in place and are undisturbed throughout the operation. The abdomen is opened. The incision which is used is, of course, dependent upon the site of the previous colostomy. It is necessary, however, to make the incision either lateral or medial, or above or below the old stomas, in order to avoid entering the bowel limbs while

opening the abdomen. In the event that the original colostomy was an inguinal type, the utilization of a paramedian incision on

always have too little spur but never too long a spur. It is essential that this paralleling be continued clear up to the point

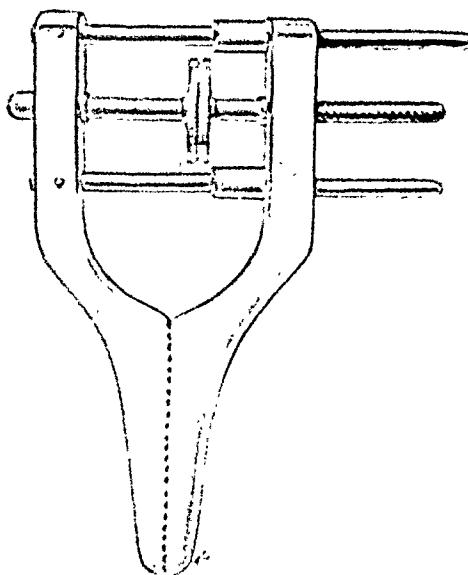


FIG. 3. Ochsner-DeBakey enterotome (full size).

the same side will give excellent exposure. The abdomen is packed off with hot lap pads in an effort to keep the small intestine from obscuring the field. Retraction is made on the wound edge toward the colostomy and the two limbs are visualized. Any adhesions which tend to obscure the easy visualization of the afferent and efferent limbs are dissected free so that the serosa of the two limbs of bowel is exposed. The mesentery of the bowel at this point is seen and noted as to whether it is lateral or medial. Usually, unless the loop has been turned, the mesentery will be medial. It is important to note this, as subsequently when the enterotome is utilized this area is avoided. The essential step in the procedure is the paralleling of the afferent and efferent limbs. This is effected by introducing interrupted sutures of silk, seromuscular in depth, from the corresponding tenia of the two limbs. It is of importance to parallel the limbs for at least six inches. Lahey<sup>12</sup> has pointed out the necessity for this step in his description of the procedure for resection of the right colon. One can

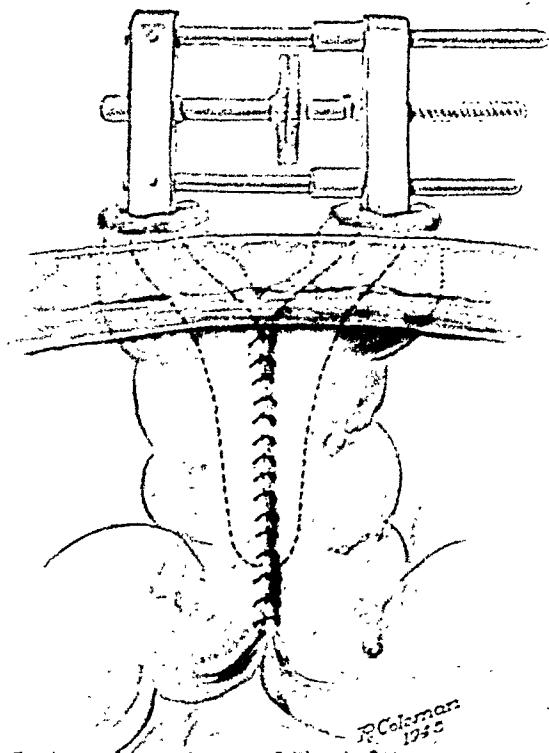


FIG. 4. Cross section showing enterotome in place.

directly under the parietal peritoneum, to close the point that a loop of small bowel might become enmeshed later and cause an obstruction.

After the two limbs are paralleled in this manner the abdomen is closed. No other procedure is done at this time. The collodion seals are removed later and the patient allowed to convalesce as in any other intra-abdominal operation. After the patient has recovered the spur is broken down. It can be seen that at the conclusion of the paralleling of the two limbs, the patient has in effect the Devine defunctionalizing colostomy. The breaking of the spur can be done as originally described by Devine, with the enterotome he devised, or by the more convenient, short handled, lighter instrument devised by Ochsner.<sup>13</sup> I have used the latter instrument.

After the spur is crushed through the patient will have stools passing through the rectum, and the two original stomas will gradually shrink down and may even completely close. In the event that they do not completely do so, it is a simple matter to free them from the skin and subcutaneous tissue and close them with catgut or steel. This can be done under local infiltration anesthesia.

Reference to the accompanying diagrams will make the steps in the procedure obvious.

There are those that will criticize this method on the grounds that it is not necessary to keep intra-abdominal spillage or contamination from occurring after the long "auto vaccination" period which the patient has had during the functioning of his colostomy. Others will believe that they can prevent serious infection from occurring with the use of the sulfanilamides. To them, I cite my first case.

Others may be of the opinion that this method causes unnecessary delay in closure and will criticize it on that point. To these patients, however, a few days or even weeks is of small moment. They have had their colostomy for months usually and are glad to do anything that will promise them an ultimate closure. The possibility of a fatality from peritonitis is dismissed and this is certainly worth while in such a procedure.

#### SUMMARY

- Peritonitis causes the majority of fatalities in intra-abdominal resection and anastomosis of segments of the intestine.

- The anastomosis or resection of portions of the colon, a portion of the bowel containing virulent micro-organisms, carries a higher incidence of mortality than does the small intestine.

- Operations designed to prevent spillage into the abdomen at the time of

performance of either "stoma" or "entero-enterostomy" procedures have been advocated.

- Under such headings are the principles of Heinecke, Mikulicz, Paul, Lahey, Glassman, McNealy and Devine.

- "Loop type colostomies" are used at the present time and may be closed at a later date.

- The closure of such "loop type" colostomies constitutes an intra-abdominal anastomosis of the large bowel in most instances.

- Mortality may be high in closure of these colostomies in spite of "auto vaccination" and sulfonamide drugs.

- A procedure utilizing the paralleling principles of Mikulicz, and also the intra-abdominal characteristics of the Devine colostomy closure is presented.

- This procedure has been used in two cases with excellent results.

#### REFERENCES

- OCHSNER, ALTON, DEBAKEY, M. and ROTHSCHILD, J. The defunctionalizing colostomy. *J. A. M. A.*, 113: 568, 1939.
- SHAMBAUGH, PHILIP. Peritonitis as a factor in the mortality of gastrointestinal surgery. *Ann. Surg.*, 104: 382, 1936.
- DEVINE, H. B. Carcinoma of the colon. *Brit. M. J.*, 2: 1245, 1935. Operation on a defunctioned colon. *Surgery*, 3: 165, 1938. Excision of rectum. *Brit. J. Surg.*, 25: 351, 1937.
- MCNEALY, R. W. and LICHTENSTEIN, M. Cecostomy. *Am. J. Surg.*, 36: 3, 1937.
- GLASSMAN, JACOB. Personal communication, 1938.
- MINTER. Cited by Alexius McGlannan, Dean Lewis: Practice of Surgery. Hagerstown, Md., 1934. Prior & Co.
- PAUCHET, M. *Pract. Chir.*, 19: 132, 1934.
- HEINECKE, W. H. Compendium der chirurgischen Operations und Verbandlehre. 3d ed. Erlangen, 1884. E. Besold.
- MIKULICZ, J. Surgical therapy for carcinoma of the large bowel. *Verhandl. d. deutsch. Gesellsch. f. Chir.*, 1902.
- DEVINE.<sup>3</sup>
- PAUL, P. T. Colectomy. *Brit. M. J.*, 1: 1139, 1895.
- LAHEY, F. Surgical Practice of the Lahey Clinic. P. 461. Philadelphia, 1942. W. B. Saunders.
- DEBAKEY, M. and OCHSNER, A. *Surgery*, 5: 947, 1939.



# RAPID REHABILITATION IN THE SHIPBUILDING INDUSTRY

KENNETH A. KOERBER, M.D.

Medical Director, Cramp Shipbuilding Company

PHILADELPHIA, PENNSYLVANIA

**T**HE conservation of health, life, limb and productive man-hours is as vital a necessity in the shipbuilding industry as it is for all industry and for the welfare of the nation.

A properly staffed and equipped medical department contributes in a large measure to the correct functioning of the individual and of the group. It is the duty of the medical department not only to select, rightly place and keep the employee physically fit but also to do all in its power to bring about rapid rehabilitation to the sick and injured. In the execution of this responsibility, the medical department serves the applicant, the employee, the management, the insurance carrier as well as the local, state and federal health authorities. Its contacts emanate further to the various industrial departments and department heads, to the hospitals and specialists, to the family and the family physician.

## FUNCTIONS OF THE MEDICAL DEPARTMENT

The main functions of the medical department may be classified as follows:

*Pre-placement Examinations.* This examination should be carefully performed together with the indicated laboratory studies, in a proper appraisal of the applicant for the particular position for which he applies. Today this care in selection and placement is most important since industry, especially a heavy industry, finds it necessary to draw upon every available ounce of manpower. The immediate needs call for the extension of employment to the partially disabled, the young, the old, and the female, in occupations which in peace time were denied to them. Proper placement protects the health of the employee against sudden mishap and insures maximum productiveness. Records of this

initial examination will aid in later treatments and decisions should the employee become ill or injured.

*Periodic Examination.* These examinations are a safeguard against excessive absorption of toxic substances, for those engaged in occupational disease hazards and against progressive physical deterioration of the employee with known disability or of advanced years.

*Care of Non-occupational Sick and Injured.* In an effort to preserve and keep in the best of condition all available manpower, the medical department also relieves the momentary discomfort of the employee who becomes ill. It renders preventive care and suggests proper health measures for the protection of all workers from infectious and contagious diseases. At the time of the initial treatment for immediate relief the patient is advised to consult his family physician for any further medical care. Generally speaking a patient sent home via the dispensary should return by the same route for a final check-up before resuming work.

*Care of the Occupational Sick and Injured.* This function produces the greatest volume of work for the medical department and much depends on the proper preventive measures that are taken. Although the safety measures are the responsibility of the safety department, there must be absolute co-operation and co-ordination of the medical and the safety departments to prevent mishap, render medical care when it is indicated and establish a bulwark against the recurrence of accidents. Medical care of the injured includes first aid treatment and investigation at the source of the accident, medical care at the dispensary and adequate hospitalization or specialist's attention when such is required.

## MEDICATIONS, TECHNICS AND PROCEDURES EMPLOYED

To keep workers on the job every possible moment, we have developed a few special technics, established certain procedures and adopted new ideas and specific medications which seemed to aid in bringing about the rapid rehabilitation of the sick or injured. Methods which facilitated speedier return to work were chosen in preference to old though established procedures provided satisfactory recovery was brought about rapidly.

The following is an account of some of these technics and procedures followed, as well as a few of the interesting experiences encountered:

**Eyes—General.** Needless to say, the eyes which are so vital and so indispensable represent a very large percentage of the injury cases, even though the safety department furnishes goggles for all occupations and requires safety glasses when refraction is needed. Every eye case, regardless of complaint is observed for foreign body, and infection or contagion. The hands must be washed before each eye examination and a drop of antiseptic must be instilled at the termination of the treatment. The proper care of the eye demands ready and immediate reliance upon the ophthalmologist and hospital upon the slightest indication.

**Eyes—Flash Burns.** In an all electric shipyard one of the outstanding sources of eye injuries are "flash" burns or actinic conjunctivitis, caused primarily by the ultra-violet ray produced when the welder strikes his arc. Often the "flash" is not evident at the time when it occurs but a worker may some time after exposure be seized with a severe sunburn of the eyes and perhaps of the face, generally mild, evidenced by itching, burning, redness and photophobia, bilaterally equal and at times reaching such proportions as to cause sufficient swelling of the lids to prevent their opening. This type of case is treated by instilling drop by drop at

two minute intervals, a combination of one of the following medicaments which are dissolved in 1:1000 adrenalin, the choice being dependent upon the severity of the condition:

	Per Cent
Pontocaine. . . . .	$\frac{1}{2}$
Butyn. . . . .	$\frac{1}{2}$
Pontocaine. . . . .	2
Butyn. . . . .	2
Cocaine HCl. . . . .	2
Cocaine HCl. . . . .	4

The latter four are seldom used and then only in severe cases and are supplemented by ice-cold wet compresses. Further relief can be obtained by a thin film of pontocaine ointment or nupercaine ointment. When severe, the pupil is often under spastic constriction which is relieved by the addition of a drop of homatropine solution.

Every welder is given upon request, and especially when needed, a  $\frac{1}{4}$  ounce dropper bottle of specially prepared "Welder's Drops" containing the following prescription:

Pontocaine	$\frac{1}{4}\%$
Ephedrine SO <sub>4</sub>	$\frac{1}{4}\%$
Menthol (Filter)	$\frac{1}{10}\%$
Glycerin	$5\%$
Boric acid sol. qs.	$100\%$

The welder leaves the dispensary having received a final antiseptic of argyrol, neosilvol, mereresin 1:1000 or butyn and metaphen ointment, usually relieved to return to his duties and less frequently to be sent home with a pair of dark glasses. When severe, he is sent home with a quarter-ounce dropper bottle containing pontocaine  $\frac{1}{2}$  per cent dissolved in 1:1000 adrenalin to be used as needed.

**Eyes—Foreign Bodies.** These cases receive the same initial constricting and anesthetic droplet and the same concluding antiseptic droplet as do "flash" burn cases. The majority of foreign bodies are found loose within the lids but many are found superficially or deeply imbedded upon the cornea. Many may have entered hot producing a charred areola. Those which have been on the cornea over

night, become more deeply imbedded and have a succulent grayish-white areola.

Occasionally, a foreign body penetrates the scleral conjunctiva and lies loosely upon the sclera with no indication of the point of penetration. However, by close scrutiny this latter opening may be found.

The foreign body upon the cornea is brushed first with a wet and then with a dry cotton applicator in a direction away from the pupillary area. At times it may be necessary to use the eye spud and if there is a charred or grayish areola the spud is followed by gentle curettage with a bur. Every case having had a foreign body imbedded upon the cornea receives an instillation of 1 or 2 drops of homatropine solution followed by butyn and metaphen ointment and the eye is covered with a pad and patch. The patient is required to return repeatedly until fully recovered. Between ten to twenty-one days after cessation of all medication the patient receives a test of visual acuity which is compared with the record of his vision at the time of employment.

Cases in which the foreign body has lodged itself upon the cornea in the pupillary area are sent directly to the ophthalmologist. In such an injury, having created a possible decrease in visual acuity, it is considered most important not to further traumatize the area with a possible difficult removal of foreign body. These cases require the slit lamp at the hands of an experienced ophthalmologist.

*Eye—Infections.* We have seen a large variety of eye infections including pink eye, pneumococcus, gonococcus, streptococcus and mixed infection conjunctivitis. We have seen an occasional acute epidemic keratoconjunctivitis with the smear containing lymphocytes and no micro-organisms. The gonococcic, streptococcic and pneumococcic infections have responded rapidly to the application of large quantities of sulfallantoin ointment\* which gave no unfavorable reactions.

*Eye-Detached Retinas.* Occasionally, these cases develop sometime after a blow to the head or the eye. Immediate hospitalization and specialist's care are recommended for any patients who, some weeks after a blow on the head, complain of bizarre types of faulty distorted vision.

*Burns—General.* It is our belief that there is no satisfactory singular treatment applicable to all burn cases owing to the various types and mixture of degrees of burns and their particular locations. Burns are treated as indicated and our armamentarium includes ointments such as phenol 3 per cent, pontocaine, sulfallantoin, and jellies such as Amertan, tannipaste, etc., and liquids such as foile cod liver oil and A & D ointments. Fairly good results have been obtained by using a mixture of gentian violet and sulfanilamide added to the tannic acid jellies. Occasionally, a macerated sloughing burn requires a wet dressing of normal saline, aluminum subacetate or Dakin's solution. Generally speaking, a nice clean healing of burns has occurred with the vitamin A & D ointments and cod liver oil. Infected burns seemed to be brought under control more easily with wet dressings, sulfallantoin ointment or a sprinkling of sulfanilamide covered by cod liver oil dressings as developed by our Dr. De La Re Signor.

*Burns—Infectious.* Sulfallantoin ointment is used extensively and freely when the slightest indication of streptococcic infection arises. If a complicating lymphangitis or lymphadenitis occurs, the lymphatic absorption of toxic substances is often arrested by making two or three incisions above the wound and at right angles to the line of lymphatic drainage. These incisions are generally 1 to 2 inches in length and apart. If indicated they go through the subcutaneous tissue and if further indicated the space between is undermined and a rubber dam inserted. The wound itself is not connected by a dam. This same method has been used in rattlesnake bites. A sulfallantoin, bichlo-

\* Sulfallantoin Ointment is manufactured by the Schuylkill Laboratories.

ride of mercury or aluminum subacetate wet dressing is applied.

*Burns—Extensive, Superficial.* These

deeply punched out weld burns. A 50 to 50 mixture of sulfanilamide and tannic acid is applied for as short a time as possible over



FIG. 1. Crushed fingers; picture shows hemostats on arteries, lacerated tendons, compound dislocation of joints.

are treated primarily for their discomfort and with antisepsis. Burns with blisters are treated by surgically preparing the part and thorough cleansing with hot soapy water, débridement of all dead skin, and the application of ointment pressure dressings. The dressings are changed as infrequently as possible (even ten to fourteen days).

*Burns—Weld Burns.* These are a common occurrence and leave a deeply punched out area indolently healing by granulation with frequent marginal erosion and excrecence and with a marked tendency to oozing, maceration and secondary infection either giving a localized ugly appearance or an extensive angry cellulitis. At this stage the wound gives a similar appearance to a secondarily infected varicose ulcer and treatment is begun by rest, elevation and wet dressings of aluminum subacetate or bichloride of mercury for twenty-four hours or the use of sulfallantoin ointment.

Dr. G. Hubert Moffes of our staff has devised a method for the treatment of

the affected area. The drawback in the use of this procedure is that it requires critical daily observation and withdrawal upon the first indication of excessive caustic action or the occurrence of a dermatitis medicamentosa which may assume extensive proportions. To minimize either reaction and prolong the ability to use this method a 25 to 25 per cent sulfanilamide and tannic acid mixture is prepared by adding a 50 per cent diluent of zinc oxide powder, starch or talc. Better results were obtained when sulfallantoin powder was substituted for the sulfanilamide.

We are aware of the fact that tannic acid has been largely abandoned in the treatment of burns especially in the above mentioned strength but believe that tannic acid has a useful place in the treatment of burns and other lesions when proper selection is made and careful critical observation is followed. Burns always looked cleanest and healthiest when an ointment containing A & D vitamins was used.

Another valuable procedure has been the early surgical conversion of the punched

out molten metal burn by excision to a surgical wound and a straight clean, rapidly healing apposition of skin edges with an



FIG. 2. Same hand as shown in Figure 1 as it appeared one week later.

ultimate neat, surgical scar instead of the jagged one which would have resulted. For this procedure, the entire bed of the wound must be excised.

*Burns—Molten Metal in Peculiar Locations.* Among these the most frequent is the ear with actual burn of the ear drum which may be sufficient to be penetrating or at least cicatricial. The nose at times will be the recipient of a droplet of molten metal. One individual opened his mouth sufficiently wide to have a piece of molten metal lodge on his vocal cord. The ear is treated with auralgan and a pontocaine ointment tampon and as the healing progresses a change is made to boric acid powder or Sulzberger's iodine powder.

*Injuries of the Fingers and Toes.* Many individuals catch their fingers or toes between pieces of heavy metal. Quite often these fingers are caught in such a manner that amputation would ordinarily be in order but upon closer scrutiny one finds that the nail has been ripped from its base

and the soft parts violently torn from their bony attachments. At times the curvature of the finger tips remains in reasonable contour, at other times it may be torn to shreds. Again the bone may be badly splintered or be left reasonably well intact. Surprisingly good results have been obtained by the use of the following procedure:

Anesthesia is by customary nerve block and at times supplementing this by dropping a number of tablets of procaine and adrenalin into the open wound. All bony splinters are removed. The ragged torn edges are carefully brought into their proper position and sutured. This suture must be preceded by a number of unorthodox deep, long-stay or anchor sutures which in healing maintain the normal contour of the finger and hold the soft parts snugly together and to the bone. These sutures quite often are crosswise over the open wound or straight through from the tip and emerge at the region of the distal joint.

If the wounds are freely oozing, sulfallantoin powder is used because of its hemostatic effect. They generally receive an initial thin coating of the ointment for its penetrating effect and are dressed as infrequently as possible. Redressings consist merely of changes in dressings and moistening with alcohol.

The success in these cases seems to be due to the careful apposition of the ragged edges, the maintenance of a snugness of soft parts to the bone by the unorthodox retention sutures, and maintenance of dryness during healing. Occasionally, a finger tip of excellent appearance four to six weeks after healing, has distorted slightly six months later due to constriction of the cicatrix.

This industry is fortunate in having Dr. Hans May, reconstructive surgeon, as a member of its staff. An example of his work is found in Figures 1 to 8. These photographs show extensive lacerations of dorsum of the left hand and fourth and fifth fingers, separation of extensor tendons of

the third, fourth and fifth fingers, compound dislocation of the middle joint of the fourth finger, and the terminal joint of the

Many fingers and toes, when crushed, have a painful accumulation of blood beneath the nail. The medical profession is



FIG. 3.



FIG. 4.

FIG. 3. Same as Figure 2 taken from a different angle.

FIG. 4. Hand of patient in Figures 1, 2 and 3, as it appeared three weeks after injury showing function of all joints.

third finger, and comminuted compound fracture of the terminal phalanx of the third finger. The treatment consisted of excision of wound, reduction of dislocations and fractures, and tenorrhaphy and the local and parenteral administration of sulfanilamide. Figures 5 to 8 show the result five months after the operation.

quite familiar with the nail drill which is customarily used to relieve this condition. We, however, have abandoned this procedure entirely. We pay our respects to one of our U.S. Navy trained pharmacist mates who gave us the subtle, painless technic of penetrating the nail by burning. As yet we have constructed no particular

FIG. 5.



FIG. 6.

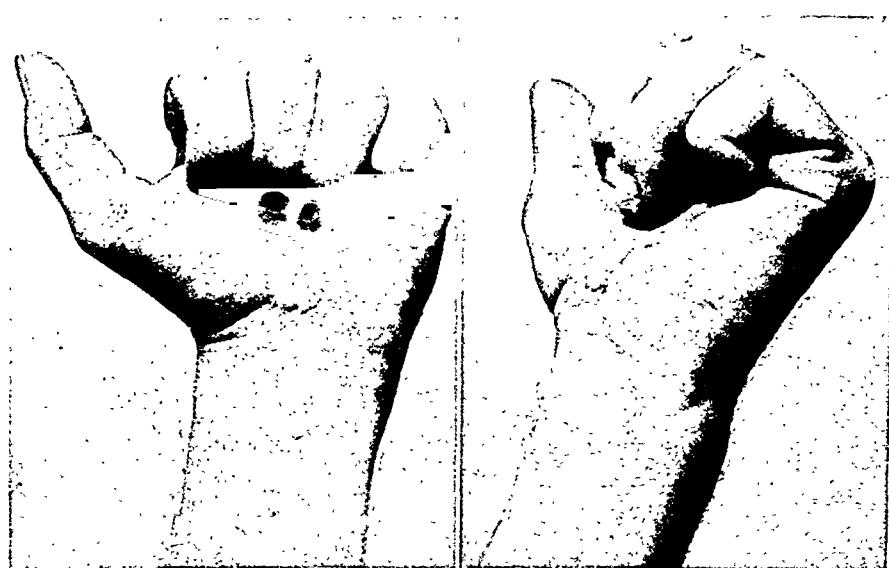


FIG. 8.

Figs. 5 to 8. Four views of hand in Figures 1 to 4 as it appeared five months after operation.

instrument but our procedure is to grasp a large suture needle with a hemostat. The eye end is heated by an alcohol lamp and when quite hot it is brought into contact with the base of the nail and by gentle guarded pressure the nail is immediately and painlessly penetrated. The opening can be enlarged or elongated by repetition of the procedure. The part is given a wet dressing of aluminum acetate, or if infected bichloride of mercury for twenty-four hours. (Fig. 9.)

*Fractured Metatarsals.* These have been found to heal nicely, rapidly and with least discomfort or disability by having a cobbler fasten a strip of leather one inch wide and one half inch high on the sole of the shoe one inch posterior to and parallel to the metatarsal arch.

*Spontaneous Hemorrhage.* Peculiarly interesting were cases of spontaneous hemorrhage from the superficial arterioles of the skin. One young individual, while going up the gang plank, felt moisture at his ankle, which was a pulsating bleeding. Another elderly gentleman while walking briskly suddenly saw before him spurting from his cheek a pulsating stream of blood which parabolized to the ground three feet before him. These cases did not develop a subcutaneous accumulation of blood. They were not amenable to arrest except by placing two sutures at right angles to each other through the bed and across the mouth of the opening. None required further treatment other than removal of the sutures. In one case incision to find the bleeding point was unsatisfactory and the incision was closed and the bleeding arrested by the two above mentioned right angled sutures.

*Ganglion.* The most frequently occurring ganglion is on the extensor tendons of the wrist but we have found these to occur almost wherever a tendon makes its appearance. In place of the former method of striking with a book or of aspiration, we have developed the following procedure. Under local anesthesia the skin and tendon sheath are penetrated with the point of a

widely beveled scalpel which is held at right angles to the part and the width of the blade parallel to the length of the



FIG. 9. Blood accumulation under nail; picture shows heated suture needle being applied to penetrate the nail.

tendon. In this manner one will not cut the tendon fibers but split them if the penetration is excessive, although this should not occur. The material wells out immediately and freely and the wound is snugly wrapped. This method has the advantage of complete removal of the material and the sack appears to shrink and disappear. In one case there was a recurrence. The procedure was repeated and permanent recovery occurred.

*Bursitis.* As reported in a previous paper\* "many cases of olecranon bursitis commonly known as "miner's elbow" and prepatellar bursitis known as "housemaid's knee" have been seen. These generally contain a bag or cushion of fluid, either serous, hemorrhagic, or suppurative. Often there is an area of redness, swelling and tenderness, and at times induration, which indicates a superimposed infection. Previous treatments with various ointments, hydrotherapy, electrotherapy, or incision

\* Kenneth A. Koerber et al. Sulfallantoin in industrial medicine. *Industrial Medicine*, October, 1943.

and drainage, with iodoform or rubber dam pack, proved to be slow and unsatisfactory. Such cases have been so numerous

often followed in hematomas." An occasional infected bursitis requires an additional wet dressing. (Figs. 10 to 13.)



FIG. 10. Bursitis; olecranon bursitis before incision.

that we have developed a definite technic of treatment:

"Our scalpels all have a slit in the handle. Into this slit is inserted a rubber dam about 1 in. by 5 in., very much like a thread in a needle. No anesthetic is used. The skin of the edematous area is prepared with antiseptic solution (e.g., tincture merthiolate). An incision is made using a new, sharp, beveled blade in the side of the area and continued through the bag of fluid and out the opposite side, pulling the handle with the rubber dam through the incised wound. The rubber dam then remains as a through-and-through drain. By cupping the dam, the sulfallantoin powder sprinkled in it is carried directly into the wound. The wound is then dressed with sterile gauze, and remains so for several days, depending upon the amount of drainage. When infection subsides or drainage ceases, the upper end of the rubber dam is cut to permit that opening to heal. The lower end remains open for any residual drainage. The remaining portion of the rubber dam is shortened daily and removed when healing is complete. This procedure is

Skin. Serious skin conditions are promptly referred to a dermatologist. Generally the average wound is often excessively treated by the overly conscientious attendant with a resultant frequency of revisits, increased use of supplies and delayed healing from repeated trauma of dry, adherent dressings pulling wounds open and causing unnecessary discomfort. Occasionally, a dermatitis medicamentosa arises from excessive treatment. Cleansing an injured part is most important. For this we have found magic glove with phenol effective and harmless and capable of removing much detritus when all other methods have failed.

With a large rotating staff and a well stocked variety of medicaments it is important to have a consistent program of medication, which will be followed through for proper and rapid termination of disability. Although well stocked with a large variety of ointments, standard U.S.P. proprietary and combinations thereof, we have found it wise to use ointments as little as possible. We have used tarbonis cream freely in a variety of skin conditions and have found it a valuable addition to our armamentarium.

A few successful variances in therapeutics which have been most helpful were the treatment of abrasions as though they were burns, the abstinence of the use of ointments upon lacerations which healed more rapidly when the greasy film between the severed edges was withheld and the use of the customary anesthetic, astringent pile ointment on certain indolent wounds.

Trichophytosis, especially the athletes foot, responds nicely to about three varieties of medicaments. We have used three types of modified Whitfields ointment for varying stages of trichophytosis. If markedly extensive, eroded, macerated and deeply imbedded, the patient is asked to soak his feet in potassium perman-

ganate 1:5000 on five successive days. This then is followed by nightly applications of an ointment of the following

the proper strength upon sensitive skin especially females and red heads.

Herpes Zoster, simplex and otherwise,



FIG. 11.



FIG. 12.



FIG. 13.

FIG. 11. Showing position of scalpel before incision is made for bursitis.

FIG. 12. After incision, showing technic of pulling scalpel with rubber dam through bag of fluid.

FIG. 13. Position of rubber dam remaining as a through-and-through drain.

formula, which makes a satisfactory medicament for tender skin especially in the female:

	Per Cent
Thymol.....	3
Benzoic acid.....	3
Salicylic acid.....	3
Lanolin.....	20
Petrolatum.....	21
Pontocaine oint.....	50

As the maceration and erosion improve the quantity of thymol, benzoic and salicylic acid is doubled to 6 per cent each and when practically healed and as a prophylactic the final formula used is:

	Per Cent
Thymol.....	12
Benzoic acid.....	12
Salicylic acid.....	12
Lanolin.....	32
Petrolatum.....	32

A valuable adjunct is the nightly sponging of the shoes with a very dilute lysol solution. An important precaution to prevent a burn is the use of the medicament only upon retiring and the use of

have been successfully treated by our Dr. La Re Signor by complete freezing of all vesicles with ethyl chloride every twelve hours. There is relief from pain and burning, rapid drying of vesicles and rapid recovery.

We rely to a large extent upon liquids, solutions and lotions as wet dressings and soaks. Our armamentarium consists of:

Boric acid wet dressings
1% Aluminum subacetate
1% Silver nitrate
1% Resorcin
1½% Formaldehyde in alcohol
Alcohol wet dressings
1:5000 Bichloride of mercury

For the cleansing of soiled hands and wounds we resort to tincture of green soap, carbon tetrachloride, peroxide, alcohol, magic glove, etc.

In passing, we wish to comment on the use of the bichloride of mercury wet dressings, which must be used with caution and when so used will prove to be a valuable adjunct for infectious wounds. The dressing can have an initial application of

1 to 5000 bichloride of mercury and be kept moist by further wetting from running tap water until moisture returns to the original. In this way there is no progressive increase in the concentration of bichloride. Its use must be guarded in the aged and those with faulty kidneys and should not exceed forty-eight hours.

*Sulfa Drugs.* Our experience has been with sulfallantoin powder and ointment sulfanilamide, sulfathiazole and sulfadiazine. For internal use we have found the sulfathiazole and sulfadiazine most desirable because of their lesser reactions than sulfanilamide. We are now using sulfallantoin internally but cannot report its action at this early date. Sulfanilamide is desirable for open wounds because of its ready solubility in the body tissues, but has the disadvantage of more probable secondary dermatitis or, as in two cases, of apparently producing an allergy which was manifested some weeks later when used again upon the same patient. Sulfallantoin has produced practically no dermatitis thus far in our work and we have been quite bold feeling reasonably secure in the use of this product which we have used freely in any variety of locations, and its free use in large quantities in the eye has given no reactions. It has the advantage of hemostasis if such is desired; however, if the surgeon desires free drainage, sulfanilamide becomes the drug of choice. An additional advantage of sulfallantoin is the fact that it provides simultaneous

bacteriostatic action and cell-proliferant action while the reason for the easy penetrating ability of the sulfallantoin ointment may be attributed to its cholesterol base. We might add that sulfallantoin proved specific in streptococcal infections but of no value in certain staphylococcal infections. To date, sulfathiazole has proved the drug of choice for internal use, though our experience with sulfallantoin and sulfadiazine is as yet limited. Sulfanilamide is still the most economical.

#### SUMMARY

An adequate staff and ample space, proportionate to the size of the plant, should be the basis for the proper function of a medical department. However, it is doubly important that its personnel be especially trained for this type of work and constantly on the alert for the development of any new methods which might facilitate the rapid rehabilitation of the injured and sick.

In this report I have tried to enumerate those cases which are commonly found in a large shipyard industry and described the technics we have found most advantageous in our efforts to shorten the time of disability of the injured employee. The various types of medications used have been discussed as well as a few odd cases which appeared in our dispensary. It is our endeavor always to seek improvements and necessary adjustments may have to be made as we go along.



# RECONSTRUCTION OF NASAL TIP

## A NEW TECHNIC

MAXWELL MALTZ, M.D.

Attending Plastic Surgeon, West Side Hospital and Dispensary

NEW YORK, NEW YORK

**R**ECONSTRUCTION of the nose is one of the earliest operations known to man, having been performed by

abdomen or even from the thoraco-epigastric area.

Strangely enough, though the repair of



FIG. 1.

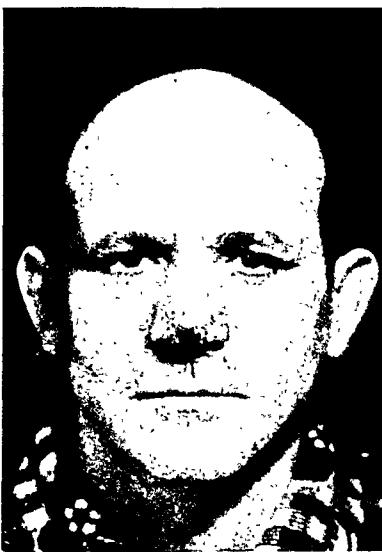


FIG. 2.



FIG. 3

FIGS. 1, 2 AND 3. Mr. G., aged forty-two, lost the tip of his nose in an accident. The deformity was quite noticeable and the patient sought immediate surgical aid. These illustrations show front and side views of the disfigurement.

surgeons in India 2,500 years ago. This, as we know, consists of utilizing skin from the forehead to cover a nasal defect, and marks the beginning of plastic surgery.

Subsequently, in the latter part of the sixteenth century, Gaspare Tagliacozzi, of Bologna, perfected the Italian method of rhinoplasty by using skin from the arm to reconstruct the nose. Since then, particularly during and after the First World War, many additions have been made to our knowledge of this particular branch of surgery. For example, Filatoff, of Russia, developed the tubed pedicle graft which Gillies, of England, popularized; so that today when a plastic surgeon attempts to rebuild a lost nose he can use a tubed pedicle from the forehead, from the arm, from the acromiopectoral region, from the

the complete loss of a nose is exceedingly difficult and complicated, the reconstruction of the loss of merely the nasal tip taxes the skill and ingenuity of the plastic surgeon just as much. That is readily understood when one realizes that the tip of the nose is the furthest away from the arteries giving circulation to the face.

Of the various methods used, naturally the forehead flap or the neck flap is the best since the texture and color of the skin from these areas approximate that of the skin of the nose. However, the apparent objection to these technics is that a considerable amount of scarring results from using integument from one visible area of the head and neck to cover another. To eliminate this objectionable factor the author wishes to report a method which he

considers very satisfactory for surgery to cover the loss of tissue of the nasal tip.

Like the skin of the face the skin of the

surface of the hand directly behind the angle formed by the index finger and the thumb. Here there is a certain amount of



FIG. 4. Author's method of forming small cylinder with interrupted sutures of fine silk. A fine roll of vaselinated gauze is inserted through the cylinder to give support to the graft.

hands is usually exposed to atmospheric conditions and for that reason the color of



FIG. 5. Sixteen days later. Tube unrolled, cut from one end of hand and brought to point of repair. Cast prevents motion of graft.

excess skin that the writer has used for the repair of a nasal tip as the case described below indicates, and because of its location, he has termed the procedure, the "Snuf Box" operation. This technic is simple and can be advantageously incorporated by the military surgeon in his



FIG. 6. Close up view showing graft growing into nasal defect.

the integument of these areas is more or less the same. Therefore, in the method advocated, the skin used lies on the dorsal

armamentarium to treat wounds of a similar nature received by soldiers on the battlefield.

The skin to be utilized is transformed into a small tube with the raw surface outward, so that in reality it is more like a

Aires, and Gillies, of London, have employed the hand as a carrier of a graft from one part of the body to another, but



FIG. 7.

FIGS. 7 AND 8. Result nine weeks later.

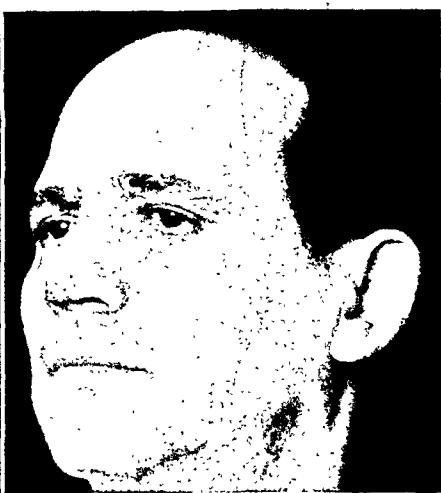


FIG. 8.

cylinder of tissue rather than a tube. The purpose of this is that, when unrolled for use on the nasal tip, it has not grown to itself and is, therefore, flat and not bevelled as would occur when unrolling the Filatoff-Gillies tube. When ready, the unrolled cylinder is detached from one end of the hand and brought to the point of repair. Two to three weeks later the graft is liberated from its other attachment to the hand and the surgery of the nasal tip is finally completed.

The important thing to remember is that the cylinder of skin must be prepared while the thumb is in abduction, so that the function of the fingers is in no way impaired. Another practical suggestion is to use the left hand in right handed individuals. Naturally the skin contiguous to the wound on the hand resulting from the preparation of the graft is undermined and approximated with interrupted sutures of silk.

Free grafts, like those from the upper eyelid and from behind the ear are of value to cover certain small defects of the face; but in defects of the nasal tip where the circulation is poor, such free transplantation is very risky, and its chances of "taking" cannot be compared with the certainty of a tubed pedicle graft.

It is true that Ivanissevich, of Buenos

at no time, to the author's knowledge, has the skin of the dorsum of the hand been utilized to repair a defect of a nasal tip.



FIG. 9. Hand with thumb in abduction indicating no loss of function of digit. Scar barely visible for practical purposes.

#### REFERENCES

1. FILATOFF, N. *Vestnik Oftalmol.*, April and May Nos. 4-5, (Russe), 1917.
2. GILLIES, H. Uses of tubed pedicle flap. *Am. J. Surg.*, 43: 201-215, 1939.
3. MALTZ, M. New method of tubed pedicle skin grafting. *Am. J. Surg.*, 43: 216-222, 1939.
4. WEBSTER, J. P. Thoraco-epigastric tubed pedicles. *Surg. Clin. North America*, 17: 145-184, 1937.
5. SMITH, C. L. Reconstruction about nasal tip. *Am. J. Surg.*, 43: 223-236, 1939.
6. IVANISSEVICH, O. Quoted in Hunt, H. *Plastic Surgery of Head and Neck*.

# PYOGENIC LIVER ABSCESS IN THE AGED

CAPTAIN ROBERT S. SMITH, M.C.

Pasadena Area Station Hospital

PASADENA, CALIFORNIA

PYOGENIC liver abscess is diagnosed rarely in the later decades of life and is characterized by a very high mortality. The general pathologic features of pyogenic liver abscess in individuals of advanced age are the same as in younger groups, but in the aged this disease presents certain special clinical considerations.

Ochsner, DeBakey and Murray, in an analysis of 830 cases of pyogenic liver abscess collected from the world literature, with forty-seven additional cases reported from the Charity Hospital and Touro Infirmary of New Orleans, have estimated the chief incidence of this condition to be in the third to fifth decades of life. The reports of Collins, and Rothenberg and Linder also emphasize the importance of pyogenic liver abscess as a disease primarily of middle age. On the other hand, every series of cases of pyogenic liver abscess includes a small percentage of patients past the fifth decade of life, and in these individuals the condition is usually fatal. It is only by early diagnosis and carefully planned surgical treatment that the mortality rate of pyogenic liver abscess in individuals of advanced years can be improved.

Leaving out of consideration all liver abscesses of amebic type, the causes of pyogenic abscess of the liver may be classified under the following headings: (1) Direct spread of infection from a contiguous suppurative process; (2) extension of infection to the liver from a more distant intra-abdominal focus by way of the portal system; (3) traumatic introduction of infectious agents; (4) embolism, infection being brought to the liver from an obvious focus by the general circulation and (5) cryptogenic, primary, or idiopathic infection, in which an antecedent inflammatory

lesion cannot be demonstrated. Pyogenic liver abscesses may be single or multiple and are found in the right lobe in the majority of cases. The usual infective agents have been reported to be the staphylococcus, streptococcus, *Bacillus coli*, *Bacillus mucosus capsulatus*, or a combination of these organisms. St. John, Pulaski and Ferber found an anaerobic non-hemolytic streptococcus as the causative agent in one infection of primary type. In the aged, pyogenic liver abscess is commonly due to a direct extension of infection from a suppurative process of the extrahepatic biliary system. In acute cholecystitis, associated with cholelithiasis, calculi may penetrate the wall of the gall-bladder to cause a solitary abscess of the adjacent hepatic parenchyma. When the spread of infection to the liver is by way of a suppurative cholangitis, multiple liver abscesses are the rule.

The significant findings in a typical case of pyogenic liver abscess are chills, fever of irregular septic type, pain and tenderness in the region of the liver, and hepatic enlargement. Nausea and vomiting are not characteristic symptoms. Jaundice occurs late, usually in the case of multiple abscesses, and is of ominous import. The blood usually shows a marked leukocytosis with an increase in the percentage of polymorphonuclear cells. The characteristic roentgenologic finding is an elevated, immobile diaphragm. Complications are frequently produced by extension of infection from the primary liver focus, particularly when operation is delayed; and the clinical picture is altered under these circumstances according to the direction of the extension and the organs which are secondarily involved. The most common complicating extension is to the chest to

produce an empyema or lung abscess; or the general abdominal cavity may be involved with the production of a peritonitis or subphrenic abscess. Rare complications include rupture into the pericardium, abdominal wall, inferior vena cava, or thoracic duct. A generalized pyemia may occur in any case.

Treatment of pyogenic liver abscess, in general, is surgical, since without operative intervention, the outcome will almost invariably be fatal. When the diagnosis is made, the plan of surgical approach must be determined exactly, since the type of drainage instituted is a factor of great prognostic importance: When the abscess is located anteriorly in the lower portion of the right lobe, the abdominal approach is indicated and the operation is best performed in two stages. When the infection involves the dome of the right lobe, drainage is accomplished by a posterior operation, the abscess being opened by a two-stage transpleural procedure or best by a completely extraserous approach. According to the principle of staged drainage, the serous membranes are packed or sutured at a first operation, and evacuation of the liver abscess is then accomplished with great safety by a second operative procedure. The posterior extraserous approach to an abscess of the dome of the right lobe depends upon the resection of the twelfth rib, with retroperitoneal dissection to expose the liver. In any drainage operation, the great danger lies in the contamination of the virgin pleura or peritoneum; and diagnostic aspiration of an abscess is only justified at the time of actual surgical drainage as a guide to the operator.

The general mortality rate in pyogenic liver abscess treated surgically is high, according to the various series of cases reported. Collins has reported a general mortality rate of 54.5 per cent in patients undergoing surgical drainage. The analyses of Ochsner et al. tend to show that a definite relationship exists between the type of operative procedure employed and the mortality rate. These investigators

found a 72.7 per cent mortality in patients drained by the transperitoneal route, a mortality of 66.6 per cent in those drained by a transpleural approach, and a mortality of 33.3 per cent in patients treated by the extraserous operation. Rothenberg and Linder found a general recovery rate of 58.3 per cent in their series of patients with pyogenic liver abscesses treated surgically. Of twelve patients drained by the abdominal route, 41.7 per cent lived; of twelve patients drained by the transpleural technic, 75 per cent lived. The occurrence of complications has been found to increase the mortality rate of pyogenic liver abscess to 90 per cent, while multiple abscesses are fatal in 95 per cent of cases (Ochsner et al.).

In the aged group, the indications for operative treatment are the same as in younger individuals, and age alone must not be considered the determining factor when the advisability of operation is in question. As Cole has observed, old people stand laparotomy surprisingly well, provided no serious degenerative process, such as cardiac decompensation or nephritis, exists as a complication. The operability of an individual of advanced years will depend more upon his general physical condition than his age. Diagnosis in older patients is usually somewhat more difficult than in younger groups because they frequently show fewer signs and symptoms; in the aged, the onset may be more insidious, fever may be of low grade, leukocytosis not so high, and, because of an apparent relative insensitivity to pain, these patients may complain very little. When operation is performed, the peculiar susceptibility of these older individuals to shock, because of concomitant degenerative changes in the cardiorenal and central nervous systems, must be kept in mind. Careful preoperative and postoperative treatment, with a surgical technic of utmost gentleness, and a minimum period of operative time, is requisite to success in the handling of these cases.

The following cases illustrate some important considerations in the management of pyogenic liver abscess in the aged:

#### CASE REPORTS

**CASE I.** W. S., male, age seventy-three, a native of southern Germany, was admitted to St. Luke's Hospital, Boise, Idaho (Case No. 14554RA) on October 2, 1940. His presenting complaints were: a productive cough of three weeks' duration following a cold, slight fever, anorexia, and a gradual loss of weight and strength. He had been confined to bed for one week but his cough had not been relieved by ordinary medical treatment. According to his past history, he had always been thin and had had a chronic cough for years. In 1936, he was treated successfully for an acute urinary retention; and a malignancy of the prostate was suspected at that time, but not proved. The positive physical findings at the time of his admission were as follows: General emaciation, weakness, and pallor; mild pyorrhea, with tongue dry and coated; dullness to percussion over the right lung base, with breath sounds distant, and numerous coarse bronchial râles; an almost constant cough, productive of large amounts of mucopurulent sputum; heart normal, blood pressure 110/80; abdomen flat, no masses or tenderness, liver and spleen not palpable; prostate moderately and symmetrically enlarged; temperature ranging between 100° and 101°F. Examination of the blood showed: Red blood cells 4,410,000, hemoglobin 75 per cent, white blood cells 15,350, with 76 per cent polymorphonuclears; urinalysis was negative, aside from a small amount of albumen; the sputum showed pneumococci, streptococci, staphylococci, and Vincent's organisms. Roentgenograms of the chest showed an increase in density of the lower two-thirds of the right lung base. Possible diagnoses considered were: Bronchiectasis, complicated by pneumonitis; lobar pneumonia; lung abscess.

Supportive treatment, including intravenous glucose, blood, plasma, and neoarsphenamine, and parenteral administration of sulfonamides, failed to improve the patient's condition. The development of signs of pleural effusion led to aspiration of the right chest, and the removal of blood tinged fluid which showed a streptococcus on culture; but there was no improvement in the general clinical picture following thoracen-

tesis. The cough continued and the sputum became more purulent and developed an offensive odor. The temperature remained of a septic type. In the blood, leukocytosis was not marked, varying between 6,400 and 12,800.

Repeated roentgen studies of the chest demonstrated a clearing of the dense area in the right lung base noted at the time of admission, but a marked right pleural thickening was then apparent. A circular calcified area about 2½ inches in diameter, in the upper portion of the right lobe of the liver, was noted in all chest films, but this was considered to have no relation to the chest findings. On November 4, 1940, an entirely new light was thrown on the case, however, when an upright anteroposterior roentgenogram showed a fluid level in this calcified area. An upright lateral roentgenogram (Fig. 1) demonstrated conclusively a fluid-containing cavity in the mid portion of the dome of the liver. In view of this finding, a diagnosis of liver abscess with perforation into the base of the right lung was made.

Drainage of the liver abscess was carried out on November 5, 1940, using local and gas anesthesia. A segment of the tenth rib, 3 inches long, was resected in the posterior axillary line, and the abscess located without difficulty by aspiration through the adherent pleura and diaphragm. A large rubber tube was then inserted, and the thoracic wound packed open with gauze. The opening of the abscess was followed by a profuse drainage of foul yellow pus, which showed on smear the same mixed infection previously found in the sputum, and, in addition, many typical echinococcic hooklets. The roentgenological report of the findings in an upright portable film (Fig. 2) on the day following operation is as follows: "Further AP film of the chest shows some clearing of the right base. The abscess cavity in the liver is filled with air, and a drain tube leads to this cavity. There is no air seen in the right pleural sac."

Although the patient was given very active supportive treatment, he failed steadily after operation, developing a terminal paralytic ileus. He expired on November 7, 1940. The autopsy findings, as reported by the pathologist, were as follows: "The body is that of a small, poorly nourished white male, age about 70 years. The abdomen is tense. There is a rubber tube drain in the right side extending into the liver. Upon opening the abdomen, the intestines balloon

out. The thin omentum has enlarged vessels. There is some pus between the loops on the right side. The liver is 5 cm. below the costal

and fibrous. Anatomical findings: Abscess of lung, right lower lobe, extending through diaphragm into liver; terminal pneumonia,

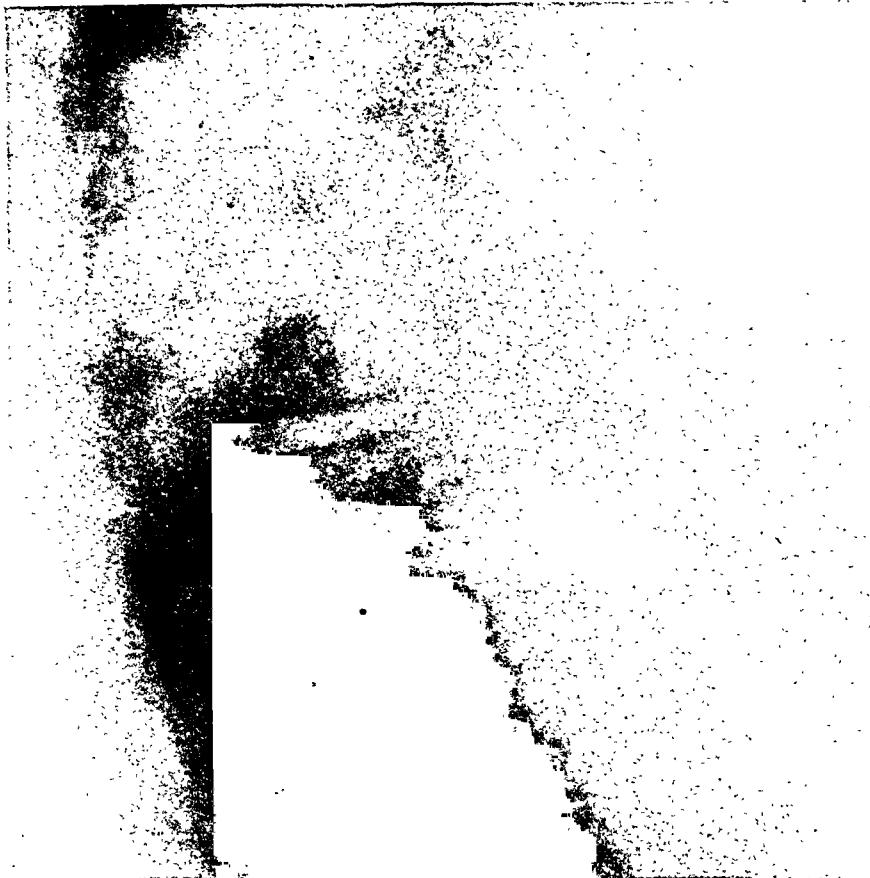


FIG. 1. Case 1. Preoperative lateral roentgenogram shows fluid level in abscess cavity of the right lobe of the liver.

margin. The liver is adherent at the dome to the diaphragm. There is some pus around this area. The prostate is enlarged. The kidneys are slightly fibrinous. There are no other gross abnormalities in the abdomen with the exception of a rubber tube extending into the liver at the point of adhesions to the diaphragm. The right lung is adherent to the pleura at the sides and posteriorly. The lower lobe is solid and dark red, and is adherent to the diaphragm. An abscess,  $4 \times 2\frac{1}{2} \times 2$  cm., is found in the lower lobe; this is continuous through the diaphragm with an abscess in the liver. There is a wall of calcium, about 4 cm. thick, about a cavity  $4 \times 3 \times 3$  cm. A new abscess has burrowed about this wall. The left lung has some fresh adhesions between the lower and middle lobes, and at the apex. The chest cavity contains about 20 cc. of free fluid. There is 15 cc. of amber fluid in the pericardial sac. The heart muscle is brown and soft. The coronary vessels are slightly beaded. The prostate is enlarged,

right lower lobe; old walled abscess of liver, with new abscess about it; acute local peritonitis; hypertrophy of prostate."

#### DISCUSSION

This case presents some unusual clinical features and the exact order and relationship of the pathologic events is not clear. The infection may have been primary in the lung, extending by contiguity, or embolism, to produce an abscess at the site of an old calcified echinococcic cyst in the right lobe of the liver. An opposite interpretation is also possible, however, and the infection may have been of cryptogenic nature, originating in the liver in relation to the calcified cyst and extending into the thoracic cavity to involve progressively the diaphragm, pleura, lung parenchyma, and bronchi. The immediate cause of death

may have been the operative spread of infection to the peritoneal cavity, but this patient's age, associated physical infirmi-

began after the patient had eaten a large amount of popcorn. She had been nauseated, vomited repeatedly, and no relief was obtained

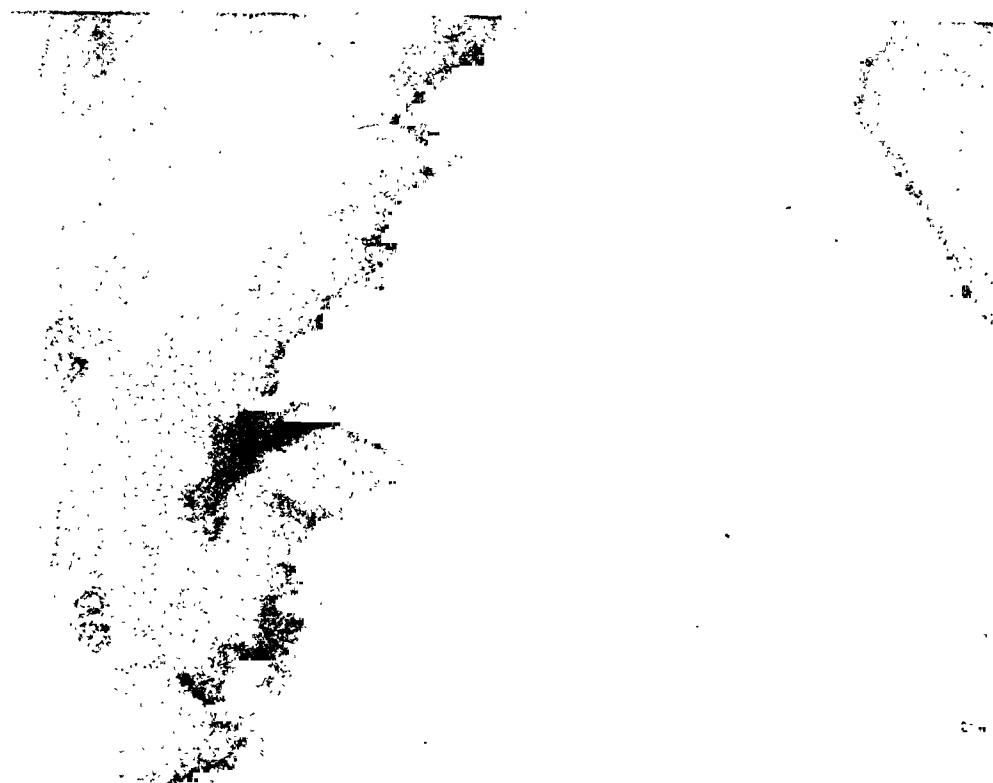


FIG. 2. Case 1. Postoperative anteroposterior roentgenogram shows air in liver abscess cavity.  
Drainage tube leads to calcified wall of echinococcic cyst.

ties and prolonged illness weighted the balance heavily against him. An earlier diagnosis, increasing his chances of survival, might have been made, if the possibility of the existence of a liver abscess had been considered earlier. A completely extraserous operative approach would have rendered infection of the peritoneum less likely and might have resulted in a favorable outcome in this case. The heavy calcified wall of the echinococcic cyst, as uncovered at autopsy, would probably have proved a very serious, if not insuperable, obstacle to the healing process under the best of circumstances, however.

CASE II. L. S., female, age seventy-five, a native of Sweden, was admitted to St. Alphonsus Hospital, Boise, Idaho, (Case No. 31122) on March 4, 1941, in an attack of acute abdominal pain of forty-eight hours' duration. The attack

by treatment at home. Two facts were considered to be of importance in her past history: Her family stated that she had had a cholecystectomy nineteen years previously, and she was known to have had a large fibroid uterus for many years. In general, she had enjoyed good health for years with no symptoms referable to the biliary tract.

On admission to the hospital, this patient appeared as an acutely ill, well preserved female of seventy-five years. The physical findings may be summarized as follows: Face flushed; nose and throat negative; chest clear; heart normal except for a slight tachycardia, blood pressure 165/100; abdomen showed an upper right rectus scar, a slightly tender mass in the right upper quadrant which was interpreted as a Riedel's lobe of the liver, and marked tenderness and muscle guard in the right lower quadrant; in the pelvis a fibroid uterus the size of a large grapefruit was found, the other pelvic organs being atrophic. The temperature was

100° F. The white blood cell count was 22,000, with 90 per cent neutrophiles. The urine was essentially negative.

beneath the recently healed laparotomy scar, in the right side of the abdomen. Incision into this obvious mass was made, under local anesthesia,



FIG. 3. Case II. Roentgenogram before drainage of liver abscess, shows elevation of right leaf of diaphragm.

The clinical picture suggested an acute surgical abdominal condition, either an intestinal obstruction or an acute inflammatory process in the right lower abdominal quadrant. An emergency laparotomy was carried out on March 4, 1941, using a lower right rectus incision. An appendectomy was performed and constricting adhesions in the region of the ileocecal valve were removed. Other dense adhesions in the region of the right lobe of the liver were found at operation. Aside from a large fibroid uterus, however, nothing else abnormal was found in the abdomen. After operation the wound healed well, but there was a persistent moderate daily elevation of temperature. A roentgenogram of the chest on March 13, 1941 (Fig. 5) showed the lung fields to be clear, with a moderate elevation of the right leaf of the diaphragm. In the fourth post-operative week, after several bouts of unexplained high fever, a bulging became apparent

on April 9, 1941, and a profuse discharge of pus and bile was obtained. A culture taken from this purulent discharge showed a staphylococcus. Following insertion of a soft rubber tube,  $\frac{1}{2}$  cm. in diameter, small dark calculi appeared in the drainage, and during the next week about thirty of these appeared on the dressings. The appearance of these biliary calculi in the drainage demanded a reinvestigation of the past history of a cholecystectomy, and a search was instituted for the record of the patient's gallbladder operation nineteen years previously. The patient's old record (from 1922) was located and found to include an operative note indicating that a cholecystotomy, with the removal of calculi and complete excision of the mucous membranes of the gallbladder had been performed at the time of the original operation instead of a true cholecystectomy.

The patient developed a deep abscess of the left thigh within a week of the opening of the

abdominal abscess, necessitating incision and drainage on April 14, 1941. From this questionably metastatic lesion, a staphylococcus was cultured.

One week after the patient's return home, the drainage tube was removed and the remaining sinus quickly closed. She was quite well during the next three months, and recovered



FIG. 4. Case II. Roentgenogram shows abscess cavity of right lobe of the liver filled with lipiodol. Drainage tube is in place.

Roentgenograms taken after the injection of lipiodol into the drainage tube on April 29, 1941, showed a large abscess cavity in the lower portion of the right hepatic lobe (Fig. 4), and no connection with any portion of the extra-hepatic biliary system could be demonstrated. A large rubber tube,  $2\frac{1}{2}$  cm. in diameter, was inserted on May 1, 1941. Thereafter, the drainage rapidly diminished, and roentgenograms taken on May 9, 1941, indicated marked diminution in the size of the abscess cavity. The patient was discharged on May 17, 1941, after approximately ten weeks in the hospital. It is of interest to note that during this period of treatment for a severe pyogenic infection, her white blood cell count ranged most of the time between 11,000 and 16,000. Her mental faculties failed considerably under the strain of her illness and she was completely irrational a great deal of the time.

almost entirely her old mental equilibrium. On August 17, 1941, however, she was sent to St. Luke's Hospital, Boise, Idaho, (Case No. 68473) for emergency operation, when she developed a painful mass in the right subcostal region, associated with fever and a moderate leukocytosis. Using local anesthesia, incision was made directly over this mass to open widely a large thick-walled abscess cavity. This abscess involved the right lobe of the liver and the overlying abdominal wall, and was connected at one point with a shrunken fibrous tube, which was lined with granulation tissue and undoubtedly represented the remains of the gallbladder. The abscess cavity contained bile-tinged pus and about twenty biliary calculi of various sizes. Using forceps and scoop, all calculi were removed, and the cavity flushed out thoroughly with saline. A large rubber tube drain was then inserted and the wound closed

loosely, using through-and-through silkworm gut sutures. The patient had a convalescence following operation which was stormy at times, due to the instability of her central nervous system. Her highest post-operative temperature was 102° F. on August 25, 1941, the first day she was tried out of bed. Thereafter her temperature subsided, and she continued to be up, leaving the hospital on September 20, 1941, with a small drainage tube in place. Post-operatively, repeated roentgen studies following lipiodol injection showed a progressive diminution in the size of the abscess cavity. At no time was a connection between the abscess cavity and the common bile duct demonstrated and no biliary calculi were apparent in the films.

This patient's drainage tube was removed shortly after her return home, and her sinus promptly closed. She quickly recovered physical and mental vigor. At the present time, after almost two years, her family physician reports that she is enjoying good general health and has no abdominal symptoms.

#### DISCUSSION

This case represents a statistically much more common type of pyogenic liver abscess than Case 1. The pathogenesis of the infection is clear, since in this patient the presence of calculi in the abscess cavity indicates a rupture of the infected gallbladder into the hepatic substance. The operations by which drainage was accomplished in this case constitute an undeliberate, but successful, staged surgical procedure. In this aged hypertensive individual, showing evidence of definite cerebral degeneration, a primary drainage of the pyogenic liver abscess might have resulted in a quick fatality.

#### SUMMARY

1. Pyogenic liver abscess occurs rarely in the aged and is characterized by a high mortality.

2. The pathogenesis of pyogenic liver abscess in individuals of advanced years is similar to that of hepatic infection in younger groups of patients. In the aged, however, the diagnosis is frequently rendered more difficult by the fact that these older patients react minimally to the

disease process. In individuals past the fifth decade, the onset of the infection may be insidious, and the classical signs and symptoms of pyogenic liver abscess may be diminished or absent.

3. In the aged, the indications for operative treatment of pyogenic liver abscess are the same as in younger individuals, and age alone must not be considered the determining factor when the advisability of operation is in question. The type of drainage operation performed, whether transperitoneal, transpleural, or extra-serous, is determined by the situation of the lesion, as in younger patients. The peculiar susceptibility of older individuals to surgical shock, because of the likelihood of concomitant degenerative changes of a cardiorenal or nervous nature, should be kept in mind, however. Success in the handling of pyogenic liver abscess in the aged will only be attained by early diagnosis and careful preoperative and post-operative treatment. In these cases, a surgical technic of utmost gentleness should be employed, and all operative procedures should be carried out in the shortest period of time practicable.

4. Two cases of pyogenic liver abscess in individuals of the seventh decade of life are presented. In one case a fatal infection was associated with a calcified echinococcic cyst of the dome of the liver. In the other, recovery followed abdominal drainage of an abscess caused by the rupture of an infected gallbladder into the liver parenchyma.

#### REFERENCES

- COLE, WARREN H. Surgery of the liver, gallbladder and bile ducts in the aged. *Surg. Clin. North America*, 20: 47, 1940.
- COLLINS, ARTHUR N. Abscess of the liver. *Minnesota Med.*, 15: 756, 1932.
- OCHSNER, ALTON, DEBAKEY, MICHAEL and MURRAY, SAMUEL. Pyogenic abscess of the liver. II. An analysis of forty-seven cases with review of the literature. *Am. J. Surg.*, 40: 292, 1938.
- ROTHENBERG, ROBERT E. and LINDER, WILLIAM. The single pyogenic liver abscess; a study of twenty-four cases. *Surg., Gynec. & Obst.*, 59: 31, 1934.
- ST. JOHN, F. B., PULASKI, E. J. and FERBER, J. M. Primary abscess of the liver due to anaerobic non-hemolytic streptococcus. *Ann. Surg.*, 116: 217, 1942.

# RIGHT INGUINAL HERNIA FOLLOWING LOWER ABDOMINAL INCISIONS\*

A REPORT OF THIRTY-ONE CASES

MAJOR NORMAN W. THIESSEN, M.C.

FORT BRAGG, NORTH CAROLINA

SURGEONS have long been aware of the fact that right inguinal hernia may follow a right McBurney incision. In a recent comprehensive book on the subject of hernia Jason stated that right inguinal hernias "occasionally" follow a right McBurney incision. In the repair of 293 right inguinal hernias at the Station Hospital, Fort Bragg, North Carolina, a much larger group of cases than has been reported previously was encountered. Our experience has suggested to us that a defect in the transversalis fascia is the causative factor.

## LITERATURE

A few cases of right inguinal hernia following a McBurney incision have been reported in the literature from time to time. The main cause for the occurrence of the condition has been ascribed variously to (1) increased intra-abdominal pressure, (2) omental adhesions to the peritoneum at the internal ring, and (3) diminished resistance of the walls of the inguinal canal secondary to injury of the iliohypogastric and ilio-inguinal nerves.

Oudard and Jean reported eight cases of right inguinal hernia following appendectomy, in the repair of which a constant finding was diffuse omental adhesions in the hernial sac. Giordani reported four additional similar cases; at the repair of these hernias omental adhesions were not found, but weak and atonic internal oblique and transversus muscles were present in addition to the hernial sac. He ascribed this finding to stretching or section of the iliohypogastric and ilio-inguinal nerves at the time of appendectomy. Previously

Moschowitz and Neuhof had published some research work which demonstrated that section of these nerves resulted only in a temporary anesthesia in the hypogastric region and not paralysis of any muscle. Andrews corroborated this conclusion when he found that all motor fibers of these nerves are given off before they enter the surgical field. On the other hand, Watson in a recent review of the causes for the development of inguinal and femoral hernias stated that "any variety of hernia may develop after any abdominal operation." He did not state why he believed this, but inferred that the cause is increased intra-abdominal tension.

It has been only in the past few years that the rôle played by the transversalis fascia in the cause and cure of inguinal hernia has been stressed. Ferguson in his original communication suspected this when he stated that faulty development of the internal oblique and transversalis muscles weakens the internal ring and is the most common cause of indirect inguinal hernia. Cupei stated that the "elastic" function of the transversalis fascia was its most important property in the prevention of inguinal hernia. Jennings, Anson, and Wright have been so impressed by the importance of the transversalis fascia that they have proposed a repair through a midline incision. They have claimed that the only procedure necessary for a cure is to close the transversalis fascia over the stump of the hernial sac which has been ligated extraperitoneally. Zieman has stated the proposition succinctly by saying that "an anatomically perfect transversalis fascia comprising the internal inguinal ring is inconsistent with hernia of the cord."

\* From the Surgical Service, Station Hospital, Fort Bragg, North Carolina.

## MATERIAL

In the period from April, 1941, to November, 1942, right inguinal hernia was found on thirty-five patients who had undergone a previous appendectomy through an incision in the right lower quadrant. For the purpose of this study four of these cases were excluded, one because a nineteen-year interval had elapsed between the appendectomy and the appearance of the hernia; one because a left inguinal hernia had been repaired prior to appendectomy, thus indicating the probable existence of bilateral congenital hernias; and two because operation was refused.

Of the thirty-one remaining patients the right inguinal hernia in three patients followed a scar in the right lower quadrant, type unrecorded; the hernia in nine patients followed a low right rectus incision; the hernia in nineteen patients followed a right McBurney incision. These cases comprise 12 per cent of the total number of right inguinal hernias repaired in the same period.

In the group of thirty-one hernias three were recurrent, right, indirect, inguinal hernias following incisions in the right lower quadrant, and are of particular interest. The first patient developed an indirect recurrent sac, the repair of which held firmly after concurrent repair of a hernia through a previous right McBurney incision. The second patient had had a primary repair of a right inguinal hernia as a child; following a low right rectus incision for an appendectomy, the inguinal hernia recurred. In the third patient an apparently satisfactory primary repair had broken down to form an indirect recurrent sac following a right McBurney incision for an appendectomy.

The time interval between the incision in the right lower quadrant of the abdomen and the appearance of symptoms suggesting an inguinal hernia was calculated. In the three cases with an unknown type of incision in the right lower quadrant the

average time was 4.7 years. In the nine patients with a low right rectus incisional scar the interval was six years. In the nineteen cases with a right McBurney scar the time interval was 5.8 years. In short, it took approximately five years of the stress and strain of ordinary living to push the peritoneal pouch through the internal abdominal ring sufficiently to cause symptoms. It is stressed that all but four of the thirty-one hernias were the indirect type.

## COMMENT

It seems significant that so many cases of right inguinal hernia following an incision in the right lower quadrant have been found. The additional finding of other cases in which a recurrence of a right inguinal hernia has followed an incision in the right lower quadrant only strengthens the conviction that there is a definite relationship.

In Figure 1 an attempt is made to illustrate the possible anatomical reasons. The transversalis fascia which completely invests the abdominal cavity is found between the transversus muscle and preperitoneal fat as a definite layer. It is particularly clear cut when making a McBurney incision. Following it down it is found strengthening the edges of the internal abdominal ring. Any weakening of this structure will allow protrusion of the peritoneum through the opening. If we now postulate the non-closure of the transversalis fascia or its non-healing following a McBurney incision, it is clear that the internal abdominal ring is weakened if not split apart.

The technical reason for this can be demonstrated clearly. These fibers of the transversalis fascia course obliquely in the same direction as the transversus muscle. When they are split, the edges tend to retract widely. This has been proved many times by putting traction sutures through the edges of the transversalis fascia when making a McBurney incision. At the time of closure these same edges often are found

deeply retracted under the transversus muscle, where they could be missed easily by the closing suture. It is for this reason

hernias. It may be argued that these hernias may be the congenital type and would have appeared sooner or later in any event.

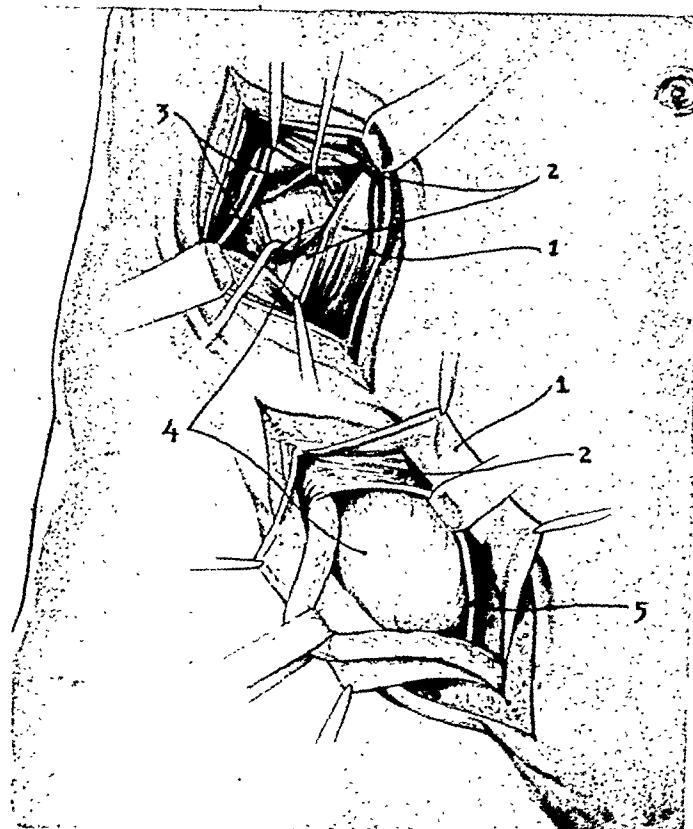


FIG. 1. This illustration depicts the anatomic continuity of the transversalis fascia between a right McBurney incision and a right inguinal incision. 1, Obliquus externus; 2, obliquus internus; 3, transversus abdominis; 4, fascia transversalis; 5, conjoined tendon.

that the practice of closing a McBurney incision with one or two sutures, or even none at all, in the internal oblique and transversus muscle layers is decried. There is little doubt, however, that many McBurney incisions closed haphazardly will heal solidly and give no further trouble. On the other hand, when in this series it is shown that one-sixth of all right inguinal hernias follow incisions in the right lower quadrant of the abdomen, the failure to take every precaution to insure a lasting result is not to be condoned.

Additional evidence to support the theory that inguinal hernias follow injury to the transversalis fascia in low abdominal incisions was found at operation for these

The absence of scar tissue rings in most of these hernial sacs, indicating the lack of the attempt at normal closure of the processus vaginalis, suggests a hernial sac of non-congenital origin. Furthermore, when the McBurney incision was felt from the inside of the abdomen, a weakness could be felt in many cases. In all cases the transversalis fascia was found stretched abnormally around the internal ring.

While it has been shown that in this series 12 per cent of a number of routine hernias have followed incisions in the lower abdomen, there was no adequate way to check the number of patients with incisions in the right lower quadrant who developed right inguinal hernias subsequently.

## SUMMARY

1. Thirty-one cases of right inguinal hernia following incisions in the lower right abdomen are reported.

2. These cases represent 12 per cent of the total number of right inguinal herniorrhaphies performed in the same period.

3. Additional evidence is presented to support the theory that the non-closure or non-healing of the transversalis fascia following low abdominal incisions is the main reason for the subsequent appearance of the inguinal hernia.

4. More accurate closure of McBurney incisions with special attention to the transversalis fascia is urged.

## REFERENCES

1. IASON, A. H. *Hernia*. Philadelphia, 1941. The Blakiston Co.

2. OUDARD and JEAN. Hernies inguinales droites apres appendectomie. *J. Chir.*, 20: 384, 1922.
3. GIORDANO, D. Dell'ernia inguinale destra postuma ad appendicectomia. *Riforma med.*, 43: 961, 1927.
4. MOSCHOWITZ and NEUHOF. Quoted by Iason.
5. ANDREWS, EDMUND. Quoted by Iason.
6. WATSON, L. F. Embryologic and anatomic considerations in etiology of inguinal and femoral hernias. *Am. J. Surg.*, 42: 695-703, 1938.
7. FERGUSON, A. H. Oblique inguinal hernia; typical operation for its radical cure. *J. A. M. A.*, 33: 6-14, 1899.
8. CUPEI. Die Bedeutung der Fascia transversalis fur die Entstehung der Leistenhernia. *Monatschr. f. Unfallb.*, 42: 122-128, 1935.
9. JENNINGS, W. D., ANSON, B. J. and WRIGHT, R. R. A new method of repair for inguinal hernia considered in reference to parietal anatomy. *Surg., Gynec. & Obst.*, 74: 697-707, 1942.
10. ZIEMAN, S. A. The fallacy of the conjoined tendon; the etiology and repair of inguinal hernia. *Am. J. Surg.*, 50: 17-21, 1940.
11. ZIEMAN, S. A. Importance and distribution of transversalis muscle from viewpoint of the surgeon. *Arch. Surg.*, 45: 926-934, 1942.



# THE RÔLE OF ASEPTIC BONE NECROSIS IN HIP LESIONS\*

ERNST BERGMANN, M.D.

NEW YORK, NEW YORK

THE arrangement of vessels supplying blood to the femoral head is unique. It is, therefore, in the hip joint more



FIG. 1. Healed fracture of the femoral neck in adolescent; proximal fragment in state of total necrosis;  $\mathbf{r}$  indicates starting fibrous invasion.

than anywhere else in the skeleton, that the sequelae of impaired blood supply can so readily be observed. Indeed, what is commonly known about aseptic necrosis of bone, is largely due to studies of the pathological status of the femoral head.

Among the various causes of impaired blood flow to the upper end of the femur, those of traumatic origin are seldom the object of controversy since they are best understood.

*Fractures of the Femoral Neck.* Of prime significance among the traumatic hip lesions is the intracapsular fracture of the neck. The arteries, running through the inner lining of the capsule and entering the neck at the capsular attachment are thus eliminated, leaving intact only the small vessel of the ligamentum teres. Except in early life, this vessel is unable to

provide for a sufficient collateral circulation to the head fragment. Generally, it supplies but a very limited area of the head, that is the zone around the "fovea," seat of the attachment of the ligament. With increasing age the ligamentum teres grows thinner and thinner, and at a period of life at which the majority of hip fractures occur, it may have altogether disappeared.

The fractured head, thus largely or entirely deprived of nutrition, undergoes aseptic necrosis and behaves more or less like a free bone transplant. This, however, does not necessarily mean that far reaching or permanent damage ensues. While it is true that necrotic bone takes no active part in the process of consolidation, the adjacent living bone of the distal fragment can unite with the head before this has gone through all the stages of reorganization. This fact has been established beyond doubt on the strength of microscopic sections. (Fig. 1.) It is also known from experimental, clinical and radiological observations, in which bone transplants become firmly incorporated at a time when the revitalizing process throughout the transplant cannot possibly be finished or even be well under way.

Therefore, the importance of more or less extensive necrosis of the head should not be overestimated as far as bony consolidation is concerned. In this connection it is illuminating to compare former statistics on hip fractures with those of recent years. In the pre-Whitman era bony union was indeed an exception. Figures as low as 6 per cent were then reported, most of these fortunate results probably being due to impaction. It is Whitman's merit to have recognized the importance of an exact reduction and to have worked out a

\* From the Orthopedic Service of Bellevue Hospital, Dr. Arthur Krida, Director.

method of achieving reduction and of securing its maintenance. By this method bony consolidation could be secured in

The incidence of necrosis of the head has, of course, been the same before and after Whitman. Beside the lack of blood

FIG. 2.



FIG. 3.



FIG. 4.



FIG. 5.



FIG. 2. Healed fracture six months after Whitman procedure; valgus position.

FIG. 3. Same as Figure 2 two years later; late collapse.

FIG. 4. Bony union after Whitman procedure; slight valgus position.

FIG. 5. Same as Figure 4 two years later. Extensive residual necrosis, collapsed and walled off.

about half the cases. By the introduction of internal splintage, be it nail, screw or bone peg, these figures could further be improved upon, so that at present cases of bony union average about 75 per cent and reach over 90 per cent in the hands of some.

supply there seem to be other reasons for the precarious outcome in intracapsular hip fractures. The other main difficulty lies with the sources of new bone formation. The most important medium for callus formation is the periosteum and this is

absent within the joint, at least its main layer, the "cambium." The central fragment cannot actively participate in pro-

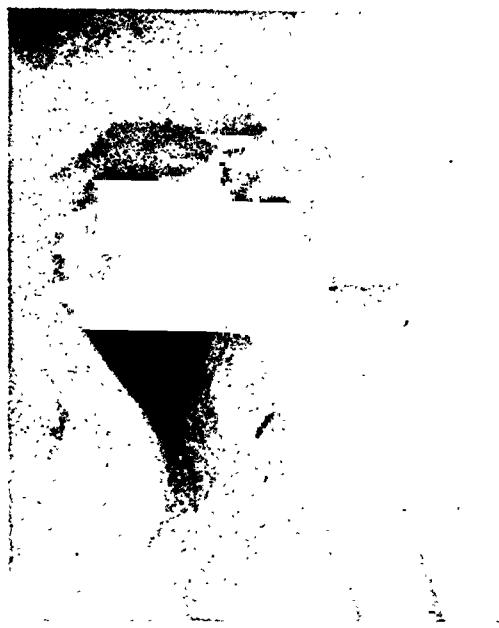


FIG. 6. Collapse of the head three years after nailing; slight valgus position.

ducing callus. That leaves the endosteum of the distal fragment as the only source from which new bone is laid down. Endosteal callus is inferior to the periosteal in amount if not in quality. In no event does the distal fragment produce sufficient new bone to bridge a major gap between the fragments, hence the outstanding importance of proper alignment and dependable retention. With these premises fulfilled, the chances for bony union are good, no matter how extensive the necrosis of the head may be. On the other hand, when reduction is unsatisfactory, the prospects of bony consolidation are poor no matter how much alive the head may be.

Our failures, therefore, cannot simply be dismissed with the remark "no blood supply." Usually reduction has been insufficient from the beginning or it has not been maintained for some reason or other.

The true significance of aseptic necrosis of the head comes to light after healing of the fracture. In a comparatively small number of cases, for which no exact figures

can be given, but which may be estimated ranging from 10 to 20 per cent, there develops a pathological fracture, a depression of that part of the head which is mainly subjected to weight bearing. This "late damage" usually occurs one to two years after consolidation of the fracture, while its groundwork has been laid at the moment of the injury. The collapse of this wedge-shaped sector of the upper quadrant may be followed by its separation from the rest of the head, a process not unlike the detachment of a joint mouse in osteochondritis dissecans. The fact that this collapse occurs at a time when all necrotic bone should long ago have been replaced led Phemister to assume that the process of repair may stop before its completion. It may well be that such areas of arrested repair occur much oftener than they become evident through their collapse. It appears that healing in valgus position of the head favors the infraction of these residual necroses. For it is in these cases that the head protrudes laterally and out of the acetabulum, leaving only a narrow sector for carrying the body weight.

This late collapse may occur after any of the approved methods of treatment. It has been observed following the Whitman procedure; it may be seen after insertion of a Smith-Petersen nail as well as after use of an autogenous bone transplant. (Figs. 2 to 8.)

In all these cases bony union of the fracture preceded the ultimate collapse of the head. Only then do the mechanics of weight bearing come fully into play.

Nothing, it seems, can be done to prevent the ultimate break down of an area of defective repair, nor can its occurrence be predicted. Equally undecided remains the question whether one method of treatment is more likely to entail ultimate collapse than the other. As is the case with internal splintage in general, the superiority of an autogenous bone graft over nail or screw is more a matter of personal belief than of proved evidence. For the object of immediate fixation the metallic device is

as efficient as the bone peg. Whether the latter carries an additional biological effect is difficult to say. Greater statistical mate-

Figure 9 is an x-ray of a fractured femoral neck, fourteen weeks after insertion of a bone peg. The specimen originates



FIG. 7. Healed fracture after bone pegging.



FIG. 8. Eighteen months later collapse and demarcation of residual necrosis.



FIG. 9. X-ray of a specimen fourteen weeks after bone pegging.

FIG. 10. Cut through same specimen as in Figure 9.

rial and more specimens will have to be studied. Such specimens, on the other hand, are rarely obtained. It seems, therefore, justified to collect and report on these scanty pieces of evidence.

from a sixty-three year old man who was operated upon nine days after the injury (open reduction, bone peg, plaster spica). He died three and one-half months later from pneumonia. The x-ray shows the

transplant in good position, the fracture line still clearly visible and the fragments only in fair alignment. On a cut through



FIG. 11. Recent epiphyseal separation.

the specimen in the frontal plane (Fig. 10) it is noticed with the naked eye that the peg, as it runs through the distal fragment, is firmly incorporated. In contrast, that part of the transplant which is placed in the head fragment appears loose. In fact, the head could be moved against both the peg and the shaft, the fragments being in fibrous union. Microscopically, the head is largely necrotic as is also the transplant. Only its surface, as far as it is surrounded by the living shaft, shows signs of reorganization in accordance with its gross appearance. Nowhere are traces of new blood vessels to creep along the peg into the proximal fragment. This lack of revascularization is worth mentioning because the growing of new capillaries along the transplant into the head is said to be facilitated by this sort of fixation.

On the other hand, one must bear in mind that the process of bony repair in this particular arrangement differs from the ordinary. Here we have the necrotic head, consisting of cancellous bone, and then, there is the dead transplant made up of massive cortex bone. Cortex, as is known from experiences, needs by far more time for being transformed into living bone

than does spongiosa. Thus consolidation of the fracture and reorganization of the necrotic head may be finished at a time at which the cortex transplant is still in the process of repair. That bony union failed to occur in this case does not reflect upon the method of internal splintage; it simply serves to demonstrate that in the absence of a good reduction even the use of a transplant cannot assure consolidation. As far as clinical experience goes, one fact alone speaks clearly for the biological value of the bone graft: In old neck fractures with non-union the transplant may eventually bring about consolidation, while the purely mechanical devices usually fail.

To sum up the significance of bone necrosis in fractures of the femoral neck, it may be said that due to the inactivity of the central fragment, the knitting is retarded. The late collapse of an area of residual necrosis is not a frequent complication. It is, however, equivalent to a failure despite the healing of the fracture, and it requires some sort of reconstruction.

*Epiphyseal Separation.* What applies to fractures of the neck, holds good not without qualification for epiphyseal separation. If the slipping takes place gradually, there seem to be ways of circulatory adjustment to the changed anatomical situation. But even in sudden, purely traumatic epiphyseal separation the vessels of the teres ligament alone may, at this age, provide for a sufficient collateral circulation. This is known from clinical experience and from experimental studies as well. Personal experiments, carried out some eighteen years ago and aimed at producing traumatic separation of the upper femoral epiphysis, showed that not only the articular cartilage but also the bony part may survive. The cartilage is of course kept alive by the synovial fluid, but bone and medulla tissue depend entirely on blood supply. In some instances the epiphyseal bone did not survive.

It is by no means simple to obtain an epiphyseal separation in experiment. A great deal of force and some luck is re-

quired. Oftener than not, the femur would break rather than give at the desired level. Naturally, the violent manipulation may

reduction and nailing the structural changes seemed to indicate repair and bony substitution. But another six months later,



FIG. 12.



FIG. 13.



FIG. 14.

FIG. 12. Reduction by traction of three weeks' duration, then nailed. Note the contrast in density.  
FIG. 13. Six months later structure comes back to normal.

FIG. 14. Another six months later collapse of the epiphysis.

damage the vessels of the round band. This in turn may account for the difference in outcome regarding necrosis or survival of the bony elements.

Exactly the same observations as in experiments may be made clinically. Some epiphyseal separations heal without radio-

the entire epiphysis, although healed in perfect position, collapsed. (Figs. 11 to 14.) While in the case just demonstrated the epiphysis broke down *in toto*, one may also find, like in fractures of the neck, a wedge-shaped area of residual necrosis years after reduction and consolidation. Such a devel-



FIG. 15.



FIG. 16.



FIG. 17.

FIG. 15. Slipped epiphysis.

FIG. 16. Three months after reduction.

FIG. 17. Three years later; wedge-shaped area of residual necrosis.

logical signs of necrosis. Others may run through all stages of bone necrosis and repair. Krida and I demonstrated an impressive example of this kind: In a complete epiphyseal separation all roentgenological characteristics of necrosis were present; until about six months after

opment is shown in Figures 15 to 17. Figure 15 is an epiphyseolysis in a twelve year old girl. The result of reduction with subsequent fixation for three months is shown in Figure 16. Three years later the wedge area appeared, surrounded by a zone of condensed bone. (Fig. 17). Situ-

ated at a sector not subjected to full weight bearing, it escaped pathological fracture.

Figure 18 shows such a wedge-shaped

may again be jeopardized by forceful manipulation. This holds true also for open exposure of the hip.



FIG. 18. A fully detached aseptic "sequestrum."

piece of necrotic bone in the state of complete detachment. In this case, that of an eighteen year old girl, the exact nature of the preceding hip disease remained undecided; the history suggested slipped epiphysis or Perthes' disease. There was a striking contrast between the mild clinical symptoms and the x-ray appearance.



FIG. 19. Wedge-shaped residual necrosis ten years after traumatic dislocation.

*Traumatic Dislocation of the Hip.* While ever so much emphasis has been laid on the precarious blood supply in fractures of the neck, only in recent years has it been realized that a similar predicament may arise from traumatic dislocation; and yet, it is obvious that wide tearing of the



FIG. 20.



FIG. 21.

FIG. 20. Dislocated hip.

FIG. 21. Same as Figure 20 two years after reduction.

FIG. 22. Same as Figure 21 another six months later.

By and large it may be said that aseptic necrosis plays but a minor rôle in epiphysiolysis. One fact stands out and is pretty generally appreciated: In attempting to reduce the displaced parts, no brusque maneuver should be applied. Its use is likely to do more harm than good; for what is left in the way of blood supply or has been reestablished through adaptation,

capsule necessarily blocks part or all of the vessels running in the inner lining of the hip joint. In addition, the teres ligament is here also torn, thus eliminating this source of blood supply, too. In the young adult, the preferred age group for traumatic dislocation, more store can be set by this vessel than in old age fractures of the neck.



FIG. 22.

In 1931, I reported on late changes of the femoral head following traumatic dislocation. As in the previous conditions,

its necessary section of the capsule, the following dislocation and reshaping of the head, conditions obtain quite similar to



FIG. 23.  
FIG. 23. Congenital dislocation, reduced in early infancy.  
Note the structural changes at weight bearing sector.  
FIG. 24.



FIG. 24.  
FIG. 24. Fully detached joint body in congenital dislocation.

here again we meet with wedge-shaped areas of necrosis which may collapse under the stress of weight bearing. Stewart, in 1933, was the first in America to report on similar observations. Since then increased attention has been devoted to the consequences of traumatic dislocation (Phemister, Kleinberg, Banks, Walker and others). Funsten reviewing twenty cases of dislocation found necrotic changes in six. Figure 19 shows such an area of necrosis ten years after the injury. The symptoms at the age of fifty-two were those of a moderate osteo-arthritis with only minor limitation of function. The fact that years may elapse before the ultimate damage becomes manifest assumes a certain significance in medico-legal decisions.

More extensive changes are seen in the following series, showing the course of events over a period of two and one-half years. (Figs. 20 to 22.)

It is interesting, but not altogether surprising that in those rare cases of traumatic dislocation in childhood the epiphysis may undergo changes identical with Perthes' disease, as has been observed occasionally.

In arthroplasty of the hip joint with

those in traumatic dislocation. Consequently, necrosis of the upper femoral end may develop, as has been reported by Phemister and ourselves. Even high osteotomy has in extremely rare cases been followed by necrotic changes within the head.

*Congenital Dislocation.* Conditions present in traumatic dislocation differ fundamentally from those in congenital luxation. In the latter, the capsule is intact though elongated. The capsular vessels have sufficient time to become adjusted to these alterations.

It is true that in x-ray the epiphysis frequently bears some resemblance to Perthes' disease. However, the few microscopic sections secured from such cases are different from those in coxa plana. In contrast to aseptic bone necrosis, prevalent in sections of Perthes' disease, one finds here principally living bone with the characteristics of traumatic infarction. On the other hand, the articular cartilage is fibrillated and partly necrotic, while it is perfectly normal in Perthes' disease. The damage to the articular cartilage may be explained by the traumatism of reduction and partly

by the incongruity of head and acetabulum. However, it is questionable, whether the small number of cases thus examined



FIG. 25. Specimen of Perthes' disease; *a*, connective tissue; *b*, dead subchondral bone.

allows of any definite conclusions. Be that as it may, one occasionally comes across x-ray findings in adult congenital dislocations which correspond fully to those described previously.

Figure 23 shows the hip of a thirty-two year old woman reduced in early infancy. Again we find the wedge-shaped area at the weight bearing sector of the head. She had been practically symptom-free until the age of thirty. Figure 24 shows the hip of a twenty-nine year old female unsuccessfully reduced in early childhood. Here the area of necrosis became fully detached, leaving a clearly visible defect in the center of the articular surface.

*Legg-Perthes' Disease.* In all the conditions previously discussed the aseptic bone necrosis can without much difficulty be traced back to traumatic interference with blood supply. Not so in Perthes' disease. No explanation, satisfactory in every respect, has as yet been given. Bland embolism, first and foremost considered by Axhausen, has met with little approbation and indeed is objectionable. Since other forms of vascular occlusion as sclerosis or endarteritis are entirely out of the question, one has time and again fallen back to considering traumatism of one form or other.

As gross injuries can easily be ruled out by the history, emphasis has recently been laid on minor, repeated or permanent mechanical effects such as experienced almost by the normal use of a limb. The term "microtrauma" has been coined in this connection.

Certain experimental findings lend some color to this theory. Bone tissue like an industrial material was tested for its power of resistance by subjecting it to all sorts of mechanical force. In the course of these experiments, cancellous bone turned out to be very elastic, particularly if covered with cartilage. Up to a remarkable degree of compression the bone may regain its former shape without so much as fracturing the smallest trabecula. On the other hand—and here the theory sets in—the enclosed medulla tissue with its tiny tender cells and capillaries may not withstand such pressure and die off (by thrombosis rather than embolism). This will then be followed by necrosis of the bony substance proper.

However that may be, the specimen of Legg-Perthes' disease, secured through operation or autopsy reveal the characteristics of aseptic bone necrosis. Fluid was found underneath the articular cartilage (Steele), a finding which suggests colliquation necrosis, not uncommon in necrosis of other tissues. As a rule, sections of specimen show such stages of bone necrosis and replacement as they correspond to the respective phases of the disease: living cartilage, dead bone and dead medulla, or the medulla spaces already revascularized and invaded by new fibrous tissue with the bony framework still necrotic or finally the bone proper in the process of "creeping substitution."

Some pictures as published by Axhausen and myself are here reproduced: Figure 25 shows the sequestrum-like separation of a large part of the epiphysis from the otherwise already reorganized though flattened and deformed head. The epiphyseal disc is completely ossified. The greater part of the epiphysis consists of living bone, the arrangement of its lamellae suggesting

recent reorganization. Figure 26 depicts another specimen of Perthes' disease at the height of its course. At *a* is an area of

disease. On gross inspection the mushroomed head rests on an extremely short neck. An x-ray (Fig. 32) shows the de-

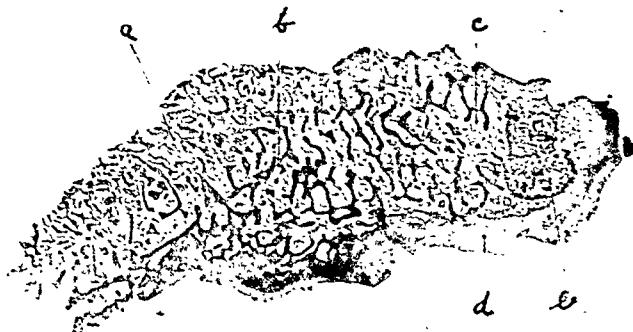


FIG. 26. Another specimen of Perthes' disease; *a*, collapsed dead subchondral bone; *b*, dead bone, not collapsed; *c*, fibrous invasion; *d*, epiphyseal plate; *e*, new bone laid down.

collapsed dead subchondral bone; *b* denotes a zone of necrotic trabeculae but not collapsed. At *c* the dead medulla is already replaced by "fibrous invasion;" *d* marks a piece of the living epiphyseal plate. At *e* the substitution of the dead trabeculae by new bone is in full swing. Figure 27 shows the femoral head of a seventeen year old boy who for several years had suffered from Perthes' disease. Figure 28 is an x-ray of the specimen. A frontal section (Fig. 29) through the middle of the head reveals on gross appearance an area of subchondral necrosis (*a*), the remains of the epiphyseal disc (*b*), a fold of articular cartilage (*c*) and the teres band (*d*). The same at low magnification is Figure 30. *a* is the articular fold, *b* the ligamentum teres. At *c* the subchondral necrosis is made up of collapsed minute fragments surrounded by dead medulla cells. The necrotic part is walled off from the adjacent living bone by a band of vascular connective tissue (*d*), containing numerous giant cells; *e* points at the remains of the disc.

Still a later stage of the disease may be seen in the following series. (Figs. 31-33.) A boy who at the age of six started with hip trouble was thoroughly followed up through the years. At the age of ten the disease had reached its clinical end stage. At fourteen he died from pulmonary

formity and marked structural changes. In the section (Fig. 33) there are still

FIG. 27.



FIG. 28.

FIG. 27. Gross appearance of the head in Perthes' disease.

FIG. 28. X-ray of same specimen.

islands of dead bone (*a*) to be seen amidst proliferation of cartilage tissue fibrillated

at its superficial layers. Bordering this zone is one of thickened living spongiosa (*b*), its spaces filled with fibrous medulla.

had had Perthes' disease at the age of nine and was subjected to wearing a brace for two years. He remained symptom-free

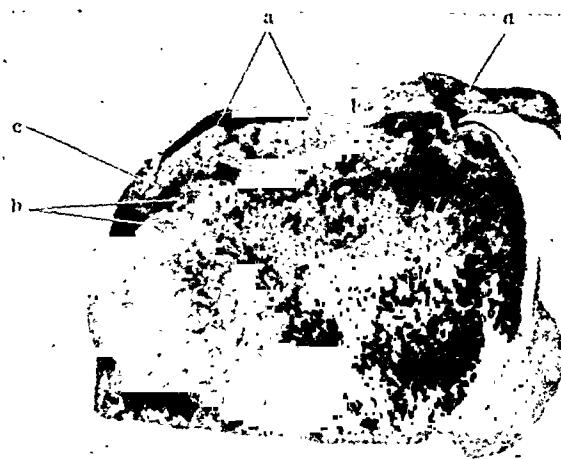


FIG. 29. Cut through femoral head; *a*, subchondral necrosis; *b*, remains of epiphyseal plate; *c*, articular cartilage; *d*, ligamentum teres.

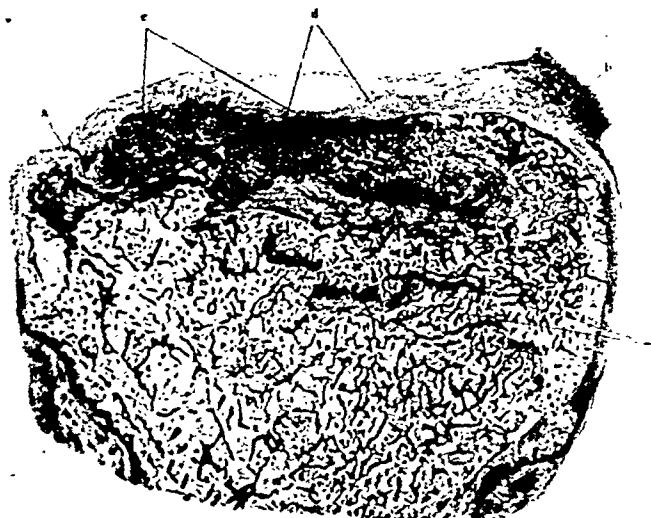


FIG. 30. Same as in Figure 29 on low magnification; *a*, articular cartilage; *b*, ligamentum teres; *c*, fragments of necrotic bone; *d*, connective tissue; *e*, epiphyseal plate.

To find residual islands of dead bone eight years after the onset of the disease and four years after its clinical conclusion is particularly significant in the light of what Phemister has so aptly characterized as a premature arrest of the process of bony replacement.

In this connection the following observation is of interest. A man of thirty years

until the age of thirty, then strained himself while bending forward and felt something snap in his hip. Ever since he had marked discomfort on walking. When first seen three weeks after that strain, a slight limitation of flexion and abduction was all that could be found clinically. The x-ray (Fig. 34) showed a somewhat flattened, laterally protruding head with a wedge-

shaped piece of demarcated bone at the weight bearing sector. Three and one-half years later he again felt a snapping sensa-

not been able to obtain free joint bodies, whatever the arrangements might have been. In Figure 36 the result of an experi-

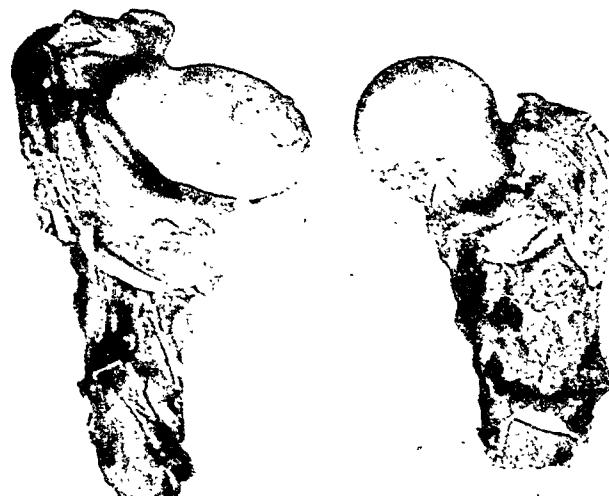


FIG. 31. Specimen of diseased and of normal hip secured by autopsy.

tion in his left hip immediately followed by "locking." It unlocked soon thereafter, but left him with a permanent pain in the hip. An x-ray (Fig. 35) revealed now a fully detached joint mouse. The development of a free joint body is rare during the acute stage of Perthes' disease; it is extremely unusual as a late complication. That it should have happened in a case so thoroughly guarded from weight bearing through two full years of continued brace wearing makes one wonder.

*Osteochondritis Dissecans.* Much has been argued about the origin of free joint bodies. One school of thought considers the joint mouse as nothing but the result of an intra-articular fracture. The other school, widely accepted, in using the term osteochondritis dissecans expresses the opinion that a part of the joint surface is gradually walled off until it becomes fully detached. It is true that this final separation of the joint body is frequently preceded by trauma. Yet to consider the whole process as a simple fracture is hardly justified. Clinical experience shows that intra-articular fractures consolidate like common ones without ever producing a joint mouse. Also in experiments, one has

mentally produced articular fracture of the femoral condyle can be seen perfectly

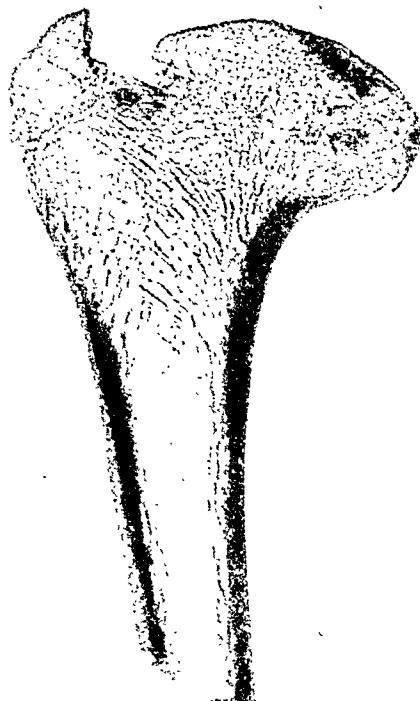


FIG. 32. X-ray of deformed head.

healed in three weeks after injury. Figure 37 shows a wedge-shaped piece of the femoral condyle fully incorporated four

weeks after it had been gouged out and immediately re-implanted.

The histological characteristics of a free

rôle. Young adults indulging in vigorous physical activities are mostly afflicted, and it is preferably the knee or elbow joint



FIG. 33. Low magnification; *a*, residual bone necrosis; *b*, living spongiosa, thickened trabeculae.



FIG. 34. Old Perthes' disease showing a demarcated area at the weight bearing sector.



FIG. 35. Same hip as in Figure 34 over three years later, presenting a fully detached joint mouse.

joint mouse also speak against its being a simple piece of fractured bone. Under its cover of living articular cartilage the bony core is in a state of aseptic necrosis, even when the body is taken out immediately after the alleged trauma. Yet in spite of all these facts, mechanical effects play a

particularly exposed to mechanical strain. The aforementioned theory of repeated traumatism to lay the groundwork of circumscribed subchondral necrosis may serve to bridge the differences of opinion.

Osteochondritis dissecans of the hip joint is not a common lesion. I had occa-

sion, fifteen years ago, to report such a condition and since then a moderate number of similar observations appeared in the literature. What made our case remarkable was that the free body had not developed from the weight bearing sector and, secondly, that the head was perfectly round, neither mushroomed nor laterally protruding.

The patient, a twenty-four year old man, had been in perfect health until two months prior to admission. At that time he noticed pain in the knee without preceding trauma. On clinical examination the hip joint allowed only a spring-like motion as if in the state of locking. The x-ray showed an almond-sized piece of the head apparently fully detached and originating from the lower medial quadrant. (Fig. 38.) Anterior arthroscopy brought to light a fully detached joint mouse of more than almond size with part of the teres band attached to it. The defect in the femoral head was lined with a layer of reddish-brown connective tissue. The microscopic

*Caisson Disease.* Among the non-traumatic bone lesions based on impairment of circulation, those arising from gas



FIG. 36. Experimentally produced articular fracture, healed three weeks after injury.

embolism in caisson workers are best understood, largely due to the instructive reports of Phemister and his associates. Their observations have since been confirmed from different quarters. Systematic examinations of caisson workers have brought to light such changes in about one-third of their number with only a very few being actually ill.

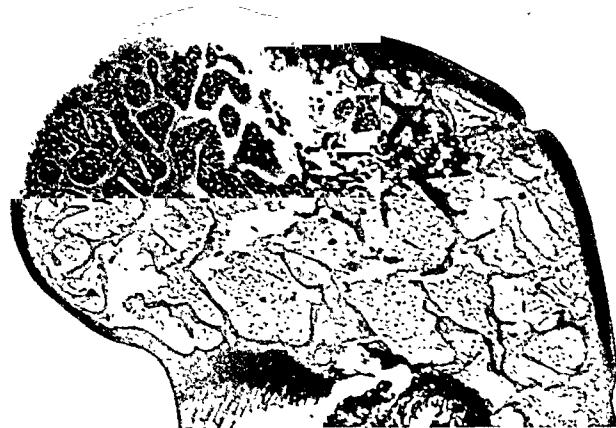


FIG. 37. Wedge-shaped piece of femoral condyle, fully incorporated four weeks after being gouged out and reimplanted (experiment).

appearance (Fig. 39) was the usual, well known from the free bodies of knee or elbow joint: the articular cartilage essentially alive, the bony part mainly in the state of aseptic necrosis. In the subchondral zone there was some apposition of new bone, the only feature not quite in line with the ordinary appearance of a joint body.

From the material of Bellevue Hospital, Walker reported an interesting case. This patient, twenty-six years ago, had worked as a sand hog and upon rapid decompression instantly developed an acute attack of bends. After several weeks he was able to resume heavy work as a carpenter until 1939 at which time he was grossly incapacitated by increasing stiffness and pain

in his left hip joint. The x-ray (Fig. 40) revealed advanced osteo-arthritis changes of this joint and also extensive bone



FIG. 38. Osteochondritis dissecans of the hip.

infarctions in the femur and tibia of the same side. (Fig. 41.) These infarctions in the shafts and metaphyses, in silent areas as it were, had never caused symptoms. The osteo-arthritis hip was fused by

bends on various occasions. On admission he was only able to move with his right lower extremity crossed over the left one. The right hip appeared locked in full adduction. An x-ray of the right hip (Fig. 42) showed a collapse of the entire weight bearing surface, the head protruding laterally out of the socket. The left hip, also to some extent limited in motion, revealed similar changes though perhaps less advanced. Nowhere were there infarctions of the long bones. In the presence of a bilateral involvement of the hips a plastic procedure was decided upon. On exposure of the right hip, the collapsed part of the articular surface proved to be a completely detached piece of articular cartilage with a small layer of subchondral bone attached to it. Upon trimming down the upper femoral end to allow the insertion of a vitallium cup, numerous subchondral cysts were encountered.

*Osteo-arthritis.* Aseptic bone necrosis is not ordinarily a feature of osteo-arthritis,



FIG. 39. Same as in Figure 38. Microscopic section of the joint mouse; *a*, dead bone; *b*, dead articular cartilage; *c*, living articular cartilage; *d*, apposition of new bone.

operation since the other hip was perfectly normal.

Another patient with caisson disease was operated upon by Dr. Krida. This forty-six year old man had worked as a sand hog up to two years prior to admission. From then on he complained of increasing pain and stiffness in his right hip. He had had

yet occasionally it may be. As to the order of events; it is perhaps more appropriate to say that osteo-arthritis may develop on the basis of an aseptic necrosis of undetermined origin. Since osteo-arthritis is not so much a disease of itself as it is a secondary development resulting from trauma, from incongruity of the joint surfaces or



FIG. 40. Advanced osteoarthritis on the basis of aseptic bone necrosis in caisson disease.



FIG. 41. Femur and tibia of the same side.

other mechanical or inflammatory changes of a joint, it may naturally follow a subchondral bone necrosis. This brings to



FIG. 42. Collapse of the weight bearing sector of the head in another caisson worker.

mind the old controversy whether the initial phases of osteo-arthritis start out from the articular cartilage or the adjacent bone. However that may be, the fact remains that not seldom do osteo-arthritis femoral heads (Figs. 43 and 44) display the familiar collapse and demarcation of the weight bearing sector, ending either in complete detachment or else in eventual re-incorporation of the depressed area. Clinically and in x-ray these hips have the same earmarks as those in caisson disease and indeed they are fundamentally of the same nature although the cause of the circulatory disturbance is unknown.

*Tuberculosis of the Femoral Head.* It may seem strange to include in this collection a condition so entirely different in nature. Yet certain forms of epiphyseal tuberculosis due to vascular occlusion through embolism by tuberculous material may be accompanied by anemic infarcts of a truly aseptic type. (Figs. 45 and 46.) Erroneously each infarcts are sometimes referred to as sequestrum. Only the super-

imposed pyogenic infection would bring about sequestration. Without mixed infection the necrotic area is aseptic and closely

plays in traumatic dislocation has in recent years been more and more recognized. From epiphyseal separations ischemic ne-



FIG. 43.



FIG. 44.

FIGS. 43 AND 44. Collapse of the weight bearing surface in osteoarthritis of undetermined origin.

resembles in microscopic section the picture of osteochondritis dissecans prior to the detachment of the joint body.

#### SUMMARY

The pathological disorder of the femoral head is largely one of aseptic necrosis. Its significance in fractures of the femoral neck is generally appreciated. The rôle it



FIG. 45. Anemic bone infarct in tuberculosis of the hip.

crosis may or may not ensue. Congenital dislocation may also entail circulatory impairment for the femoral head. While in Perthes' disease the radiological and pathological train of events is well known, the cause of the epiphysenecrosis is still a matter of conjecture. The same is true in



FIG. 46. X-ray of same specimen as in Figure 45.

osteochondritis dissecans and in those cases of osteo-arthritis which are characterized by collapsed and more or less demarcated areas of necrotic bone in the weight bearing sector. Embolic interruption of circulation to the femoral head is undisputed in caisson disease alone.

## REFERENCES

1. AXHAUSEN, G. and BERGMANN, E. Die Ernaehrungsunterbrechungen am Knochen. Handbuch d. speziellen pathologischen Anatomie von Lubarsch-Henke, Bd. 9/III. Berlin, 1937. J. Springer.
2. BANKS, S. W. Aseptic necrosis of the femoral head following traumatic dislocation of the hip. *J. Bone & Joint Surg.*, 23: 753, 1941.
3. BERGMANN, E. and KRIDA, A. Aseptic necrosis and bone drilling. *Arch. Surg.*, 44: 81, 1942.
4. BERGMANN, E. Aseptische Knochennekrosen. *Deutsche Ztschr. f. Chir.*, 206: 12, 1927. Die Modellierung der Huesfe bei Arthritis deformans. *Arch. f. klin. Chir.*, 150: 259, 1928. Osteochondritis disseccans des Huestgelenks. *Deutsche Ztschr. f. Chir.*, 217: 400, 1929. Keilherde im Huestkopf. *Deutsche Ztschr. f. Chir.*, 223: 252, 1931. Spätschäden nach geheiltem Schenkelhalsbruch. *Deutsche Ztschr. f. Chir.*, 245: 496, 1935.
5. BORNSTEIN and PLATE. Ueber chronische Gelenkveränderungen der Pressluftarbeiter. *Fortschr. a.d. Geb. d. Röntgenstrahlen*, 18: 197, 1911.
6. DYES, O. Huestkopfnekrosen nach traumatischer Huestluxation. *Arch. f. klin. Chir.*, 172: 339, 1933.
7. FUNSTEN, R. V., KINSER, P. and FRANKEL, C. J. Dashbord dislocations—twenty cases of traumatic dislocation of hip. *J. Bone & Joint Surg.*, 20: 124, 1938.
8. KAHLSTROM, S. C., BURTON, C. C. and PHEMISTER, D. B. Aseptic necrosis of bone, etc. *Surg., Gynec. & Obst.*, 68: 129, 1939.
9. KLEINBERG, S. Aseptic necrosis of femoral head following traumatic dislocation. *Arch. Surg.*, 39: 637, 1939.
10. KONJETZNY, G. Zur Pathologie der Perthes-Calvé schen Krankheit. *Acta Chir. Scandinav.* 74: 361, 1934.
11. PHEMISTER, D. B. Fractures of neck of femur, etc. *Surg., Gynec. & Obst.*, 59: 415, 1934. Changes in bones and joints resulting from interruption of circulation. *Arch. Surg.*, 41: 436, 1455, 1940.
12. POTTS, F. N. and OBLETZ, B. C. Aseptic necrosis of head of femur following traumatic dislocation. *J. Bone & Joint Surg.*, 21: 101, 1939.
13. SAUERBRUCH, F. and BERGMANN, E. Zur Behandlung der Schenkelhalsbrüche. *Arch. f. orthop. u. Unfall-Chir.*, vol. 28, 1930.
14. STEELE, P. B. Operative treatment of Legg-Perthes' disease. *Am. Acad. of Orthop. Surg.*, Ninth Convention, New Orleans, 1940.
15. WALKER, W. A. Traumatic dislocations of the hip joint. *Am. J. Surg.*, 50: 545, 1940.



# SEDATION IN PATIENTS WITH ACUTE HEAD INJURY\*

E. S. GURDJIAN, M.D. AND MAJOR J. E. WEBSTER, M.C.  
DETROIT, MICHIGAN

THE management of the restless patient with cranial trauma is often trying and difficult. Restlessness of varying degrees, sometimes to the point of requiring restraint, is frequently encountered and is undesirable. Management calls for recognition and removal of the causes for the restlessness. The use of analgesic sedative and hypnotic drugs should be a final resort. The selection of the most efficacious and at the same time the least disturbing to the restorative processes has been of interest to us.

## TECHNIC

The technic used in this study is the same as described in a previous paper.<sup>1</sup> The cerebrospinal fluid pressure was observed continuously for one and a half to three hours by attaching a water manometer to a needle inserted between the second and third or third and fourth lumbar vertebrae; averages were recorded every five minutes. The drug or drugs were administered about fifteen minutes after the start of the experiment. In the group given chloral-bromide, repeated punctures were made at different lumbar interspaces to observe the spinal fluid pressure. The number of drops of spinal fluid lost during the puncture was noted. The blood pressure and respirations were recorded every fifteen minutes. The effect of the drugs upon pain, motor activity, color and general appearance were also noted.

## RESULTS

In this paper are discussed the results of studies of chloral-bromide, and of codein and nembutal. The effect of morphine and sodium phenobarbital upon patients with cranial trauma was presented in detail in a previous report.<sup>1</sup> Morphine was found to cause a consistent and undesirable rise

in cerebrospinal fluid pressure in cases of severe head injury. The respiratory rate was usually lowered and in some instances cyanosis occurred. In patients without apparent pain, or with no apparent cause for pain, the effect on motor activity was not uniform. In some, the restlessness continued; in others, a profound hypnosis was produced. Sodium phenobarbital in 5 gr. intramuscular doses did not influence the cerebrospinal fluid pressure, respirations, blood pressure or pulse. In many instances, it had no appreciable sedative influence.

*Chloral-bromide Solution.* A solution of 5 gr. of chloral and 15 gr. of sodium bromide in one ounce of water was administered to seven patients with cranial trauma, rectally in four instances and orally in three cases. The cerebrospinal fluid pressure was recorded by repeated punctures. (Fig. 1.) There was no increase in the fluid pressure and the drug was found to have little sedative effect except in one patient in whom a deep sleep lasting for one hour was produced.

*Codein and Nembutal.* One and one-half gr. of codein intramuscularly and 3 gr. of nembutal orally was administered in fourteen patients. Both were given intramuscularly in four cases. In Table I, the pertinent data in these cases are given. All but three had fractured skulls, and among thirteen, including three without fracture of the skull, there was bloody or xanthochromatic spinal fluid. In one instance, a significant rise in the cerebrospinal fluid pressure occurred (Case 2, with a rise of 205 mm. at the end of one hour. The pressure then dropped to below the initial level at the end of ninety-five minutes). A sedative effect was obtained in every instance except two. The patients were usually asleep ten minutes after the administration of the drugs. A slowing of

\* From the Department of Surgery, Wayne University College of Medicine and Grace Hospital, Detroit, Michigan.

the pulse was noted; the respirations also tended to lower; there was little variation of the blood pressure. Of the various drugs used, the combination of codein and nembutal was found to be superior. It was found that these drugs could be repeated to promote continued restfulness

Their control is dependent mainly upon constant nursing care and close observation.

The distended bladder may be catheterized as early as possible and usually later catheterizations may not be necessary. An adequate airway is provided by the position of the patient free from flexion of the

TABLE I

## SYNOPSIS OF HEAD INJURY CASES GIVEN NEMBUTAL GR. 3 BY MOUTH OR INTRAMUSCULARLY, AND CODEIN GR. 1½ INTRAMUSCULARLY

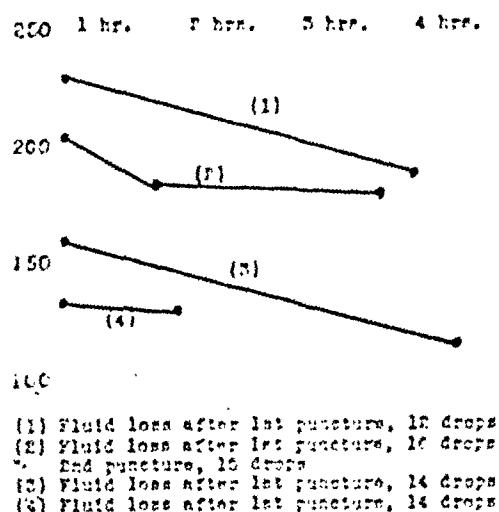
Case No., Sex	Age	Spinal Fluid	Initial Pressure	Highest Pressure	Pressure at End	Net Change	Day of Test	Fractured Skull	Vital Functions		
									Fluid Loss	Blood Pressure	Pulse
1M	66	Xantho.	155	155	150	-5	9	Yes	2 drops 150/75 130/60	68-64	18-16
2M	51	Bloody	245	450	220	+205	12	No	10 drops 145/90	85-80	20-18
3M	57	Slightly Bloody	250	270	265	+20	2	Yes	3 drops 140/90	92-86	32-28
4M	27	Bloody	720	750	590	+30	2	Yes	10 drops 130/80	56-50	16
5M	50	Clear	165	210	140	+45	11	Yes	None 125/80	84-74	23-19
6F	26	Clear	250	280	250	+30	2	Yes	5 drops 110/70	92-86	24-20
7F	58	Slightly Bloody	190	230	240	+40	8	No	3 drops 158/100 150/90	85-80	16-14
8M	24	Xantho.	270	300	300	+30	9	No	5 drops 120/70	96-94	16-13
9F	21	Xantho.	250	300	205	+50	5	Yes	3 drops 110/85 115/80	90-85	13-12
10M	?	Xantho.	350	400	275	+50	10	No	5 drops 130/75	80-68	15-12
11M	47	Xantho.	125	145	145	+20	5	Yes	8 drops 106/74	84-76	17-15
12M	66	Bloody	475	475	295	-180	5	Yes	10 drops 106/74	69-58	17-15
13M	56	Clear	260	310	205	+50	11	Yes	4 drops 145/100	78-70	15-14
14M	51	Clear	270	330	320	+60	12	Yes	3 drops 140/100 150/110	84-80	20-14
15M	39	Bloody	245	280	250	+40	9	Yes	5 drops 100/76	84-78	21-22
16M	?	Clear	158	158	150	-8	8	Yes	3 drops 130/90	82-76	18-17
17M	58	Bloody	130	150	150	+20	3	Yes	4 drops 110/56	82-72	18-16
18F	21	Bloody	215	300	300	+85	2	Yes	2 drops 104/60	65-63	16

and that fractions of the original dose were often effective as maintenance doses. (Fig. 2.)

## COMMENT

There are several factors which contribute to the production of restlessness in the injured patient apart from the stimulation due to cerebral damage. These include distention of the urinary bladder, an inadequate airway, pain from associated injuries, and discomfort from a soiled bed, noise, handling of the patient, restraints, dehydration and abdominal distention. Before sedative drugs are indicated, such factors must be considered and controlled.

neck and by a conscientious effort to remove all collecting mucus with a suction apparatus. Oxygen by means of a catheter placed in the nasopharynx may be of benefit. The patient must not be fed if any doubt exists as to the integrity of the swallowing reflex except by tube administration. Pain from associated injuries must be relieved; an adequate intake of fluid is advisable (2,000-2,500 cc.). Freedom from noise, light, movements, extremity restraints and a wet bed is helpful in promoting restfulness. When these conditions have been fulfilled, there are patients who still remain active and therefore require sedative drug therapy. In these



Chloral-Hydrate solution 0.2, 1 rectally and its effect on spinal fluid pressure in cases of head injury.

FIG. 1.

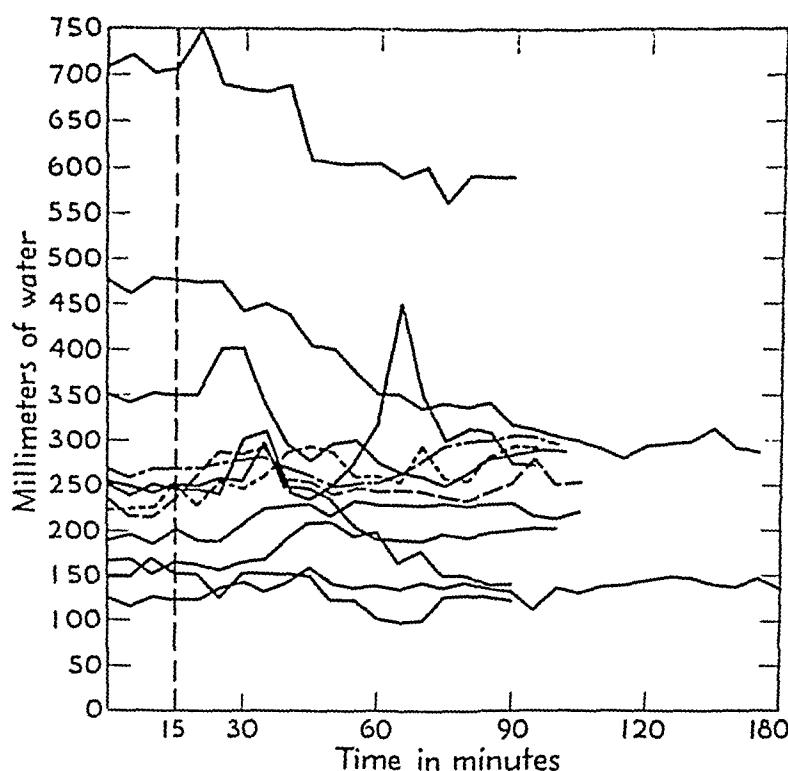


FIG. 2. The spinal fluid pressure of the first twelve cases summarized in Table I. These patients were given  $1\frac{1}{2}$  gr. of codein and 3 gr. of nembutal by mouth or intramuscularly.

studies we have now become more familiar with the effects of morphine, sodium phenobarbital, codein and nembutal, and chloral-bromide solution.

From clinical observations of the drugs evaluated, codein and nembutal appear to be the sedatives of choice, most efficaciously used in combination. They usually produce rest and the sleep brought about by their use approximates normal sleep. The action of these drugs in combination is rapid; and if the patient is not disturbed, the sleep may continue from one to five hours. The cerebrospinal fluid pressure is not significantly disturbed; there are no undesirable changes in the vital functions. However, their use should be discontinued as soon as possible. Routine administration of any sedative drug is condemned. When restlessness continues for many days or weeks, it may be desirable to change to another drug.

In material which is to be published in detail elsewhere, oxygen content, percentage of saturation and carbon-dioxide content were recorded in the normal, morphinized and nembutalized dog. The oxygen content and percentage of saturation tend to decrease slightly following the use of the drugs as also noted by McClure, Hartman, Schnedorf and Schelling.<sup>2</sup> However, the arteriovenous difference remained about the same as in the normal which suggests satisfactory utilization of the oxygen by the brain. Of course, it is admitted that simultaneous accurate blood-flow studies alone can prove this point beyond dispute. Although the available oxygen may be adequate in amount, its utilization by all or certain groups of cells of the nervous system may not be satisfactory in the presence of sedatives and narcotics. The contributions of Michaelis and Quastel,<sup>3</sup> Quastel,<sup>4</sup> and Gerard<sup>5</sup> suggest that sliced brain tissue does not absorb as much oxygen in a solution of a barbiturate but that apparently no lasting damage is done to the tissue, for the reaction is reversed and normal absorption recurs after the same tissue is taken out of the barbiturate environment. As to the similarity of results in experiments *in vitro*

compared with findings *in vivo*, one may say that surviving tissue undergoes many chemical changes tending to lower its ability to carry on metabolic activity. The dosage of the drug may also be different under varying circumstances. The work of Stone<sup>6</sup> indicates that phosphorous compounds and lactic acid in the brain change with anoxia and death but no such change obtains with the use of nembutal or morphine alone. It is our belief that although histotoxic anoxia may be a factor, the judicious use of certain narcotic and sedative drugs in moderate doses is justifiable and proper when needed.

From our experience, the use of morphine should be avoided, except when its use becomes imperative as an analgesic. Objections to its administration outnumber those of the codein and nembutal.

#### CONCLUSIONS

The use of codein in combination with nembutal is recommended for the restlessness due to cerebral injury after secondary disturbing factors have been eliminated. Codein and nembutal is effective and least harmful based upon a study of the cerebrospinal fluid pressure, pulse, respirations, blood pressure and motor activity. Their use should be discontinued as soon as possible and their routine use is condemned. The use of morphine should be avoided except when it becomes imperative for relief from pain.

#### REFERENCES

1. GURDJIAN, E. S., WEBSTER, J. E. and SPRUNK, C. J. Spinal fluid studies in acute head injury. *Arch. Neurol. & Psychiat.*, 42: 92, 1939.
2. MCCLURE, R. D., HARTMAN, F. W., SCHNEDORF, J. G. and SCHELLING, V. Anoxia; source of possible complications in surgical anesthesia. *Ann. Surg.*, 110: 835-850, 1939.
3. MICHAELIS, M. and QUASTEL, J. H. The site of action of narcotics in respiratory processes. *Biocem. J.*, 35: 518, 1941.
4. QUASTEL, J. H. Respiration in the central nervous system. *Physiol. Rev.*, 19: 135, 1939.
5. GERARD, R. W. The metabolism of brain and nerve. *Ann. Rev. Biocem.*, 6: 419, 1937.
6. STONE, W. E. Acid-soluble phosphorus compounds and lactic acid in the brain. *J. Biol. Chem.*, 135: 43, 1940; STONE, W. E., MARSHALL, CLYDE and NIMS, LESLIE F. Chemical changes in the brain produced by injury and by anoxia. *Am. J. Physiol.*, 132: 770, 1941.

# CEEPRYN\*

## CLINICAL AND BACTERIOLOGICAL STUDIES

G. B. KRAMER, M.D.

AND

S. H. SEDWITZ, M.D.

Director of Pathology Laboratories, Youngstown  
Hospital Association

Chief of Peripheral Vascular Clinic, Youngstown  
Hospital Association

YOUNGSTOWN, OHIO

**C**EEPRYN (brand of cetylpyridinium chloride) is a quarternary ammonium compound which possesses a very high degree of germicidal activity, both in the absence of serum and in the presence of 10 per cent serum. It has been shown in the laboratory to be effective against a wide variety of pathological organisms, particularly against those organisms ordinarily considered responsible for cutaneous contamination and wound infections.

Toxicity studies have shown that this quarternary ammonium compound has a very low toxicity, considerably lower than similar compounds containing the benzyl radical.

Cetylpyridinium chloride (Ceeprym brand), is a white, crystalline powder of definite chemical composition, readily soluble in water, alcohol and acetone. Ceeprym, in solution forms a neutral mixture and has the quality of lowering surface tension; therefore, solutions of Ceeprym are quite detergent.

There were four features of this new germicide that prompted its study and clinical use, namely, its high germicidal activity on a wide variety of organisms; its relative non-toxicity; its high detergence, and the fact that it did not contain any phenols or heavy metal, such as mercury, which in some cases is irritating.

In March, 1940, the use of this tincture was made routine on all the wards of the Youngstown Hospital for complete investigational study.

*Ceeprym Tinted Tincture 1:200.* Since we noted from laboratory studies that this type of compound is somewhat inactivated

by the presence of soap, we believed it was particularly adaptable to our routine method of preoperative preparation of the skin. The routine we used in all operations and all technics is as follows: When possible, the night before (or in case of emergency, immediately prior to operation) the patient has at the bed, a dry shave of the part to be prepared for surgery. There is no sterile dressing placed over the part. When the patient is brought to the operating room, the operative field is scrubbed twice, thoroughly, with ether using two separate sponges. The technic with Ceeprym is then to apply two coats of Ceeprym tincture 1:200, the first being allowed to dry partially, before the second coat is applied. We have used the above technic with this new germicide in every laparotomy, amputation (breast, extremities, etc.), dilatation and curettage, excision of glands of the neck, ligation of varicose veins, etc.

At Youngstown Hospital we have had an average of 6,000 surgical operations per year. Therefore, this clinical study covers the results in around 18,000 cases.

With one feature of Ceeprym, have we been particularly impressed, and it is this feature which we wish to stress particularly in this report: There has been no instance of irritation, and there have been evidenced no idiosyncrasies to the drug. Added to this is the important clinical point that we have had no postoperative infections during this period.

The above outlined technic of preoperative preparation of the skin, offers the following advantages in our estimation: (1) it is time saving; (2) it is fool-proof (eliminating a certain stated period of

\* From the Pathology Department and Department of Surgery, Youngstown Hospital, Youngstown, Ohio.

scrubbing) and (3) it is cheaper (the process eliminating soap, alcohol, etc.). These three points, coupled with the fact that we have observed no irritation and experienced no infections, has made us consider that Ceeprym is, in our experience, the closest approach to the ideal cutaneous disinfectant that we have been able to find.

There are also certain practical points concerning the use of Ceeprym that we wish to mention. When an appendectomy is done, for example, we have not used the purse-string type of suture, inverting the stump. When the distal end of the appendix has been severed, we touch the proximal end with phenol, then with alcohol, then with Ceeprym tincture 1:200; in addition we paint the entire cecum and the rough edges of the mesocolon with the tincture. We have experienced no irritation from this procedure.

Another practical feature in the use of this preparation is, that contrary to certain mercury antiseptics, it can be used to paint the tissues before the application of elasto-plast without resulting irritation. In the application of Unna's Paste boot, the whole leg is covered with Ceeprym tincture 1:200. These boots have been allowed to remain on for six or eight weeks in men working in the steel mills, in an environment of high temperature. In 150 patients so treated, there has been no irritation.

*Bacteriological Studies of Ceeprym Tinted Tincture 1:200.* The bacteriological investigation of a series of patients, upon whom Ceeprym tincture was to be used, applying the above preoperative technic, was undertaken to determine the efficacy of Ceeprym tincture as a cutaneous disinfectant for the operative field.

Fifty unselected, routine consecutive cases were studied. As most of the surgeons and their assistants were unaware of this study, there were no deviations in the precautions taken by them in the preoperative technic.

The following culture media were used in our study: Tryptose phosphate broth, blood agar and dextrose agar. Each batch

of culture media was first tested before use and was found to be highly satisfactory for the cultivation of streptococcus, pneumococcus, *Staphylococcus albus*, *Staphylococcus aureus* and *Bacillus coli*.

Three cultures were made, one in each media, from the skin of the preoperative field as soon as the patient was placed on the operating table and the preliminary preparatory dressings removed. Three cultures were taken on the same kind of media after the application of 1:200 solution of tincture of Ceeprym as soon as it dried and finally three cultures were made on the same kind of media after the operation was completed, just before the surgical wound was dressed. In all, nine cultures were taken from each case.

Cultures were immediately incubated at 37.5°c. and were observed and read at the end of twenty-four hours, forty-eight hours, and seventy-two hours. All cultures were taken with sterile cotton swabs, on wood applicators.

The results obtained were as follows: All cultures from the operative field before the application of 1:200 tincture of Ceeprym were positive. All cultures from the operative field, after the application of a 1:200 tincture of Ceeprym were negative. Forty-five cultures from the operative field after the operation was completed and before the surgical wound was dressed were negative. Five cultures were positive.

The organisms found in all cultures from the operative field before Ceeprym was applied were: in twenty-five cases, *Staphylococcus albus*, in fourteen cases, *Staphylococcus albus* and an air bacillus, in one case *Staphylococcus albus* and *streptococcus*, in one case *streptococcus* alone, one case colon bacillus alone, in two cases colon bacillus and *staphylococcus*, in one case an air bacillus alone, in two cases *Pneumococcus* and *Staphylococcus albus*, in one case *pneumococcus* and an air bacillus, in two cases *Micrococcus catarrhalis* and *Staphylococcus albus*.

In the five positive cultures obtained after the operation was completed were:

No.	Operation	Culture before Ceepryns Application	Culture after Ceepryns Application	Culture after Completion of Operation
1	Appendectomy	Positive Large gram positive air bacillus Staphylococcus albus	Negative	Negative
2	Herniotomy	Positive Staphylococcus albus	Negative	Negative
3	Median laparotomy	Positive Staphylococcus albus	Negative	Negative
4	Appendectomy	Positive Staphylococcus albus	Negative	Negative
5	Saphenous ligation	Positive Large gram positive air bacillus Staphylococcus albus	Negative	Negative
6	Appendectomy	Positive Staphylococcus albus	Negative	Negative
7	Appendectomy	Positive Large gram positive air bacillus Staphylococcus albus	Negative	Negative
8	Median laparotomy	Positive Large gram positive air bacillus Staphylococcus albus	Negative	Negative
9	Tumor of knee	Positive Staphylococcus albus	Negative	Negative
10	Breast tumor	Positive Staphylococcus albus	Negative	Negative
11	D & C	Large gram positive air bacillus Positive Staphylococcus albus	Negative	Diphtheroid bacillus
12	Appendectomy	Large gram positive air bacillus Positive Staphylococcus albus	Negative	Negative
13	Appendectomy	Positive Staphylococcus albus	Negative	Negative
14	Cholecystectomy	Positive Streptococcus	Negative	Negative
15	Saphenous ligation	Positive Staphylococcus albus	Negative	Negative
16	Saphenous ligation	Positive Staphylococcus albus	Negative	Negative
17	Median laparotomy	Positive Large gram positive air bacillus	Negative	Negative
18	Herniotomy	Positive Large gram positive air bacillus	Negative	Negative
19	D & C	Positive Staphylococcus albus Streptococcus hemolyticus	Negative	Negative
20	Median laparotomy	Positive Staphylococcus albus	Negative	Negative
21	Perineal repair	Positive Staphylococcus albus	Negative	Negative
22	Median laparotomy	Large gram positive air bacillus Positive staphylococcus Albus	Negative	Negative
23	Median laparotomy	Positive Staphylococcus albus	Negative	Negative
24	Circumcision	Large gram neg. & pos. air bacilli Positive Staphylococcus albus	Negative	Negative
25	Saphenous ligation	Large gram positive air bacillus Positive Staphylococcus albus	Negative	Negative

No.	Operation	Culture before Ceepryn Application	Culture after Ceepryn Application	Culture after Completion of Operation
26	Appendectomy	Positive Staphylococcus albus Large gram positive air bacillus	Negative	Negative
27	Saphenous ligation	Positive Staphylococcus albus	Negative	Negative
28	Cholecystectomy	Positive Staphylococcus albus	Negative	Negative
29	Median laparotomy	Positive Staphylococcus albus	Negative	Negative
30	D & C	Positive Staphylococcus albus Pneumococci	Negative	Staphylococcus albus
31	Repair D & C	Large gram positive air bacillus Positive Colon bacillus	Negative	Negative
32	Median laparotomy	Positive Staphylococcus albus	Negative	Negative
33	Cholecystectomy	Positive Staphylococcus albus	Negative	Negative
34	D & C	Positive Staphylococcus albus Colon bacillus	Negative	Staphylococcus albus
35	Herniotomy	Positive Staphylococcus albus	Negative	Negative
36	Median laparotomy	Positive Staphylococcus albus	Negative	Negative
37	Appendectomy	Positive Staphylococcus albus	Negative	Negative
38	Cholecystectomy	Positive B. coli Staphylococcus albus	Negative	Negative
39	Saphenous ligation	Positive Large gram positive air bacillus Staphylococcus albus	Negative	Negative
40	Saphenous ligation	Positive Staphylococcus albus	Negative	Negative
41	D & C	Positive Staphylococcus albus Micrococcus catarrhalis	Negative	Staphylococcus albus
42	Appendectomy	Positive Staphylococcus albus	Negative	Negative
43	Herniotomy	Positive Staphylococcus albus	Negative	Negative
44	Saphenous ligation	Pneumococci Positive Staphylococcus albus	Negative	Negative
45	Cholecystectomy	Positive Staphylococcus albus	Negative	Negative
46	Median laparotomy	Pneumococci Positive Staphylococcus albus	Negative	Negative
47	Appendectomy	Positive Large gram positive air bacillus Staphylococcus albus	Negative	Negative
48	Head case	Positive Staphylococcus albus	Negative	Negative
49	D & C	Positive Staphylococcus albus	Negative	Large gram negative bacilli
50	Saphenous ligation	Positive Staphylococcus albus Micrococcus catarrhalis	Negative	Negative

In one case an air bacillus alone, three cases *Staphylococcus albus* alone and in one case a diphtheroid bacillus alone.

In referring to the table it will be noted that the positive cultures obtained after the completing of the operation were from dilation and curettage operations. (Table I.)

In positive cultures, the growth appeared during the first twenty-four hours, and those cultures in which there were no growths found in twenty-four hours, such cultures remained sterile after seventy-two hours.

*Ceeprym Aqueous Solution 1:1000.* Since October, 1941, we have used Ceeprym aqueous solution 1:1000 for all surgical procedures in which a germicidal solution, irrigant, or wet dressing was indicated. Ceeprym appealed to us particularly because of the fact that it did not contain any heavy metal, which might cause a chemical irritation, and it is isotonic. It was highly germicidal against the streptococcus and staphylococcus, which is the usual contaminant where irrigations or wet dressings are indicated, and its high detergency would permit the penetration of the germicide intimately with the tissues under treatment, and would help in removing necrotic tissues.

Ceeprym aqueous solution 1:1000 was used in wet dressings for felon, glomus gangrene or thrombosis, and other minor conditions such as ingrown toe-nail and paronychia. The usual technic was the use of wet dressings for two to three days. Good results were obtained in all cases and it was significant there was no maceration nor wrinkling of tissues.

This solution was used prior to the injections of all types by means of a swab saturated with the solution. It was found that the solution cleansed the area to be injected very thoroughly and was much superior to alcohol, which is usually used for this purpose.

This solution was found very useful in contused wounds requiring débridement. The technic employed here was as follows:

the contused wound was cleansed with benzene, followed by irrigation and scrubbing, if necessary, with Ceeprym aqueous solution 1:1000.

This solution was found particularly interesting and useful in the treatment of extensive abrasions or brush burns, particularly in those cases in which small particles of foreign material were embedded in the superficial layers of the skin. The technic here was first to wash the part thoroughly with the 1:1000 solution and then to apply continuous wet dressings for two or three days. At the end of this time, when the dressing was removed it was found that a gray-green slough was present which would come off readily without leaving any bleeding points. There was no maceration of the tissues from the use of this technic.

For scalp wounds the detergence of this solution was particularly valuable, since swabs saturated with the solution could be used to clean the scalp, the friction of the swab causing quite a bit of foam which facilitated shaving. It was of particular interest, that on the scalp and on other hairy portions of the body which require swabbing prior to suture, there was no folliculitis, which can often become quite troublesome in areas of this nature.

In the treatment of *Trichomonas vaginalis* vaginitis, Ceeprym aqueous solution was used to cleanse the vagina following which a 1:200 Ceeprym powder was used. (This powder was supplied also on an experimental basis.) This combined technic in the treatment of trichomonas infection was found excellent in several cases.

It was noted in many cases that wounds, which contained a great deal of detritus, were readily cleansed of all tenacious material by irrigation with Ceeprym aqueous solution 1:1000.

Occasionally, this solution was used following rib resection to irrigate empyema following pneumonia. It was found that the cavity was cleansed, and healing and recovery was much faster in those cases in which this solution was used. This was

most likely because of the fact that Ceeprym solutions are detergent, and they permit the germicide to come into contact with the causative organisms.

In the peripheral vascular clinic, in the treatment of trophic ulcers, Ceeprym aqueous solution was found to be extremely useful in that it cleansed the ulcer thoroughly, and also removed the scaly dead skin from the area surrounding the ulcer. Quite often the tissues surrounding the trophic ulcers are quite sensitive, and in no case was irritation produced, even though it was often necessary to employ vigorous scrubbing.

#### SUMMARY\*

1. Ceeprym tincture 1:200 has been used routinely in our operative cases at the Youngstown Hospital for three years

\* This work was done under a grant from The Wm. S. Merrell Company, Cincinnati, Ohio, and the Ceeprym products were kindly supplied by this firm.

(totalling around 18,000 cases). During this time there has been observed no irritation and no single instance of infection.

2. A special preoperative technic, particularly applicable to this germicide, is outlined.

3. Complete bacteriological studies on a series of fifty surgical patients, selected at random, showed Ceeprym tinted tincture 1:200 is a highly effective, non-irritating, cutaneous disinfectant for securing a sterile operative field.

4. Ceeprym aqueous solution 1:1000 has been used for the past twenty-one months on all surgical patients requiring a germicidal irrigant or wet dressing. In this connection, Ceeprym seems to be of particular value because of its combination of high germicidal activity and detergence.

Acknowledgement is hereby given to Dr. Earl A. Brant, Chief of Staff, and Mrs. J. Spire, Chief Surgical Nurse, for valuable assistance rendered in this investigation.



# PERSISTENCE OF PAIN AFTER APPENDECTOMY

BERNARD JUDOVICH, M.D.

AND

JAMES DUNN, M.D.

Chief of Neuralgia Clinic, Philadelphia General Hospital      Lieut. Commander in the United States Navy

PHILADELPHIA, PENNSYLVANIA

**N**UMEROUS reports in the literature state that there is a considerable proportion of patients who fail to obtain relief of pain following appendectomy. Failures predominated among the group having chronic appendicitis as compared to the group who suffered acute attacks.

In the majority of the reported cases in which appendectomy failed to bring relief, the main symptoms before operation consisted of pain and tenderness. Nearly all of the writers quoted agree that right iliac pain and tenderness are invaluable symptoms in the diagnosis of acute appendicitis, but when taken alone they are practically valueless as evidence of chronic appendicitis. For years past, surgeons have recognized the fact that appendectomy frequently fails to relieve pain and tenderness in the right lower quadrant and they have made persistent search to find some explanation for these symptoms other than the appendix.

Among the larger groups reported, Alvarez made a comprehensive survey of 255 cases. Only two patients in this group obtained a complete cure of their symptoms. He states that a patient, especially an adult who submits to appendectomy, having never had an acute attack, has but one chance in a hundred of getting a permanently satisfactory result; also that there was one chance in a hundred of dying from the operation. There were four patients who had partial relief and four who lost their symptoms for several years making a total of four chances in a hundred of getting some relief. Twenty-four per cent of this series, however, became decidedly worse. Some who could stand their distress and could still keep at work prior to operation could never work

afterward. He concluded, therefore, that chances of losing heavily as compared with the chances of getting cured were thirty to one, and the chances of losing heavily as compared to getting some help were six to one. Approximately three out of four of his patients could not remember having experienced even temporary improvement after the operation.

Segal and Heinemann state that the diagnosis of chronic appendicitis is an erroneous one in each instance it is made, and indicate that pain and tenderness of the right lower quadrant is not a reliable sign of chronic appendicitis. They had arrived at these conclusions on the basis of postoperative persistence of the patient's symptoms.

Lewis reported that 40 per cent of appendectomies for chronic appendicitis failed to relieve the original symptoms.

Lichty advises against making a diagnosis of chronic appendicitis unless there is a definite history of a characteristic acute attack. Many of his patients became worse. He has seen patients who had been operated upon fourteen times, the first operation having been done for a supposed chronic appendicitis.

Warren and Ballantine in commenting upon a follow-up study of 138 cases of chronic appendicitis reports 24.6 per cent of patients unimproved, and .7 per cent worse. These cases were all reported as having normal appendices, although often operated upon during an attack of pain in the right quadrant. Their total of cured and improved patients in this series was approximately 75 per cent, as compared to the series of 255 patients reported by Alvarez in which 2 patients were cured and 8 improved, which is 4 per cent.

Other observers have reported similar results, the failures varying from 10 to 70 per cent.

of parietal neuralgia are based upon the following observations:

1. That the tenderness which is asso-

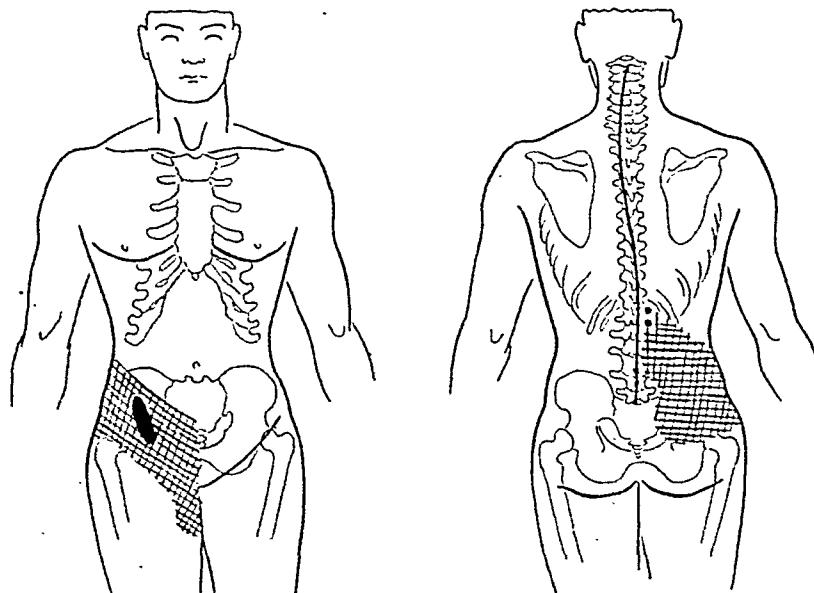


FIG. 1. E. G., age thirty-one, female: chief complaint: pain in the right lower quadrant, duration: seven years; appendectomy several years ago with no relief of her original complaint. The patient was advised sometime later that she had adhesions and possible trouble with an ovary. Examination revealed segmental tenderness involving D12 and L1 on the right side. The patient had a scoliosis and a three-fourths of an inch shortening of the right leg. A heel lift and a paravertebral infiltration of D12 and L1 caused complete disappearance of pain and tenderness in all areas. The injection was repeated on several occasions. Diathermy was administered to the dorsolumbar spine. The patient made an excellent recovery. The dark area represents the point of spontaneous pain. The hatched area denotes the zone of associated tenderness.

Carnett, and later Carnett and Bates were the first to state definitely that the pain in these patients was due to an intercostal neuralgia. In other words, the pain was in the parietes or abdominal wall, and was not due to painful stimuli from diseased viscera. Our observations over a period of years have confirmed the findings of Carnett and Bates.

Most of the patients who complained of chronic pain and tenderness of the lower right quadrant proved to be suffering from an abdominal wall neuralgia of somatic origin. Some of these patients had submitted to surgery, others had not. Many had undergone gastrointestinal and genitourinary studies with negative findings.

Reasons for concluding that these patients are frequently suffering from pain

associated with the pain is *segmental in outline*. If carefully elicited, tenderness is found not only in the lower right quadrant, but in the upper inner aspect of the thigh, the costovertebral angle, the lumbar region and the upper half of the buttock. Clinically, visceral pain is a most infrequent cause of segmental tenderness.

2. Segmental tenderness is usually associated with some disturbance *in or near the vertebral column*; it may be the roots before or after their exit, disease of the spinal nerves, or irritation of soft structures close to the spine.

3. In patients with segmental pain and tenderness, paravertebral infiltration of a local anesthetic directly into the area of the trunks which supply the painful and tender abdomen causes immediate quies-

cence of pain and tenderness to both superficial and deep palpation. Visceral pain cannot be controlled in this manner.

4. Paravertebral infiltration has not controlled pain which later proved to be due to visceral disease, or due to intraspinal lesions.

5. Many patients with chronic pain and tenderness of the abdominal wall obtain no relief by surgery, and improve or are cured of their complaints when attention is directed to the spine.

6. Many patients with chronic segmental pain and tenderness of the lower abdominal quadrants obtain relief by heel lifts, postural correction, and physical therapy to the dorsolumbar spine with no other form of treatment.

7. The majority of patients with segmental pain and tenderness obtain either improvement or cure of their complaints when treatments are directed to the spine rather than to any of the peripheral areas of spontaneous pain, or to the abdominal viscera.

The most important cause of persistent segmental pain and tenderness of the lower abdominal quadrants, is the susceptibility of the dorsolumbar spine to trauma and postural strain. Among other causes are the various factors which are commonly responsible for parietal pain elsewhere in the body, very often some form of upper respiratory infection.

Treatment may be outlined as follows: (1) Removal of foci of infection; (2) postural correction: pelvic tilt for lordosis, a heel raise for a shortened lower extremity to correct scoliosis; postural corrective exercises of Goldthwaite; (3) physical therapy: this should be applied to the spine over the irritated trunks and not to any of the peripheral areas of spontaneous pain; (4) nerve block: paravertebral infiltration of the trunks which supply the tender and painful area is the most rapid and dependable method of causing quiescence of the

patient's symptoms; (5) mechanical support: these should be used only where there is a definite lesion requiring support, as determined by x-ray and other studies.

## CONCLUSIONS

- Persistent pain following appendectomy is commonly caused by an abdominal wall neuralgia as evidenced by the segmental tenderness which is usually associated with this condition.

- Treatment should be directed to the spine and paravertebral nerve trunks, rather than to peripheral zones of pain or to the abdominal viscera.

- Surgery should not be repeated in the presence of segmental tenderness, until a segmental neuralgia is ruled out.

## REFERENCES

- CARNETT, J. B. Chronic pseudoappendicitis due to intercostal neuralgia. *Am. J. Med. Sci.*, 174: 579, 1927.
- CARNETT, J. B. and BATES, WILLIAM. *Surg. Clin. North America*, 12: 1369, 1932.
- BATES, WILLIAM. Parietal neuralgia. *Ohio State M. J.*, 34: 283-287, 1938.
- ALVAREZ, W. D. When should one operate for "chronic appendicitis"? A study of 385 cases. *J. A. M. A.*, 114: 1301, 1940.
- SEGAL, Z. and HEINEMANN, W. A critical analysis of a series of appendectomized patients. *Rev. Gastroenterol.*, 8: 286-293, 1941.
- WARREN, R., and BALLENTINE, H. Chronic appendicitis: results after appendectomy for recurrent pain in right lower quadrant of the abdomen. *J. A. M. A.*, 117: 994, 1941.
- LEWIS, GEORGE V. Chronic appendicitis. *J. Arkansas M. Soc.*, 28: 121-124, 1931.
- LICHTY, J. A. *J. A. M. A.*, 79: 887, 1922.
- STANTON, E. M. *New York State J. Med.*, 110: 406, 1919.
- GIBSON, C. L. *Am. J. Med. Sc.*, 159: 654, 1920.
- WHIPPLE, A. O. Unpublished paper read in Philadelphia, 1923.
- DEAVER, J. B. and RAVDIN, I. S. *Arch. Surg.*, 6: 31, 1923.
- BETTMAN, H. W. *J. A. M. A.*, 83: 1216, 1924.
- COFFEY, R. C. *Gastroenteroptosis*. P. 153. New York, 1923. D. Appleton & Co.
- FRIEDENWALD, JULIUS and MORRISON, THEODORE H. The clinical significance of so-called chronic appendicitis. *Ann. Int. Med.*, 5: 1-8, 1931.



# CARDIOVASCULAR AND RESPIRATORY EFFECTS FROM CELIAC GANGLIA STIMULATION IN MAN\*

S. J. MARTIN, M.D., LAURENCE MISCALL, M.D. AND E. A. ROVENSTINE, M.D.

NEW YORK, NEW YORK

**S**URGEONS and anesthetists have frequently observed circulatory and respiratory disturbances following manipulations of the viscera during intra-abdominal operations. Many laboratory experiments have been undertaken to define and explain these disturbances. Such investigations have regularly been concerned with stimulation of the viscera itself rather than the pathways for innervation and are restricted to laboratory animals as subjects. Little attention has been given to celiac plexus stimulation and to the circulatory and respiratory changes that may result. In a previous communication, it was found that faradic stimulation of the celiac plexus in the dog resulted in predominant cardiovascular and respiratory responses characterized by a rise in arterial and venous pressures, a decrease in pulse pressure, a sinus tachycardia and an inspiratory apnea.<sup>1</sup> It was suggested that such a response was dependent upon an afferent arc of the sympathetic nervous system. In this present study, the experiments were repeated in man.

## PROCEDURE

The subjects in this investigation were six patients on whom seven surgical procedures were completed by one of us (L. M.) for treatment of hypertension or other vascular disturbances. The patients were anesthetized with cyclopropane or nitrous oxide-oxygen-ether sequence utilizing the carbon dioxide absorption technic. An endotracheal airway with an inflatable cuff was employed in each instance. During operation the right or the left celiac ganglia and corresponding splanchnic nerves and sympathetic ganglia ( $L_1$ ,  $L_2$ ) were exposed through a dorsolateral incision. Before these

structures were excised or severed, they were subjected to stimulation using the Harvard induction coil with two dry cells. Before each observation, the platinum stimulating electrodes were applied to exposed skeletal muscle to verify the presence of a stimulus. The stimuli were varied in strength from minimal to maximal by changing the position of the secondary coil.

Records were taken in each experiment of changes in, (1) arterial blood pressure by a graphic method,<sup>2</sup> (2) respiratory activity and (3) serial electrocardiograms of Lead II. Control observations consisted of variations noted in these records, (1) before anesthesia, (2) after anesthesia was started and the patient put in a lateral position and (3) just before stimulation of the exposed celiac ganglion or other structures. These control observations were then compared with those made during or shortly after a ten to thirty second interval of faradic stimulation of the celiac ganglia. Each ganglion was stimulated at least twice. A total of twenty-two observations were completed. In some instances, the intact and the central end of the severed greater splanchnic nerves were stimulated.

In Table I is summarized briefly the average predominant changes noted upon faradic stimulation of the celiac ganglia in man.

It is readily seen that in each instance, the arterial blood pressure was increased varying from 18 to 56 mm. of mercury systolic blood pressure and from 0 to 32 mm. of mercury diastolic blood pressure. The degree of change depended largely upon the strength of stimulation employed. The systolic blood pressure elevation was more marked than the diastolic as is indi-

\* From the Division of Anesthesia, and the Second Surgical Division, Bellevue Hospital, New York City.

cated by the increase in pulse pressure (11 to 38 mm. of mercury). The pulse pressure was never decreased. Changes in heart rate noted in the electrocardiogram were surprisingly variable but not marked. The heart rate increased in some and de-

stimated with faradic current in each patient. In all instances, the elevation in blood and pulse pressure and extent of apnea were markedly augmented. The heart rate was generally unaffected. No fall in blood pressure occurred.

TABLE I  
AVERAGE CHANGES IN CIRCULATORY AND RESPIRATORY RESPONSES NOTED FOLLOWING FARADIC STIMULATION OF THE CELIAC GANGLIA IN MAN

Cases Employed	Celiac Ganglion Stimulated	Blood Pressure mm. Hg.		Pulse Pressure mm. Hg.		Heart Rate (Ecg.)		Respiratory Rate per min.	
		Preop.	Before Stimul.	After Stimul.	Before Stimul.	After Stimul.	Before Stimul.	After Stimul.	Before Stimul.
No. 1—F. D., male, 30. Dx: Hypertension with Cardio-vasc. Disease. Surg: Left coel. gang. removal with T11, L1, 2, (cyclopropane)	Left Right	170, 100 160, 80	184, 90 125, 65	235, 120 145, 74	94 60	115 71	66 84	88 100	20 36
No. 2—L. S., male, 55. Dx: Periph. Vasc. Dis. with Varic. Ulcers. Surg: Rt. Coel. Gang. & great & lesser splanx. (N <sub>2</sub> O-ether)	Right	116, 70	140, 68	158, 70	72	93	78	99	30
No. 3—J. D., male, 56. Dx: Hypertension Surg: Left Coel. Gang. (N <sub>2</sub> O-ether)	Left	126, 70	135, 75	182, 84	60	98	78	90	36
No. 4—S. H., male, 49. Dx: Hyperten. with c-v Dis. Surg: Rt. Coel. gang., great & lesser spl. nerves. (N <sub>2</sub> O-ether)	Right	202, 130 205, 130	245/145	75	100	100	111	36	12
No. 5—A. R., male, 40. Dx: Hypertension Surg: Rt. Coel. gang. & splan. nerves. (N <sub>2</sub> O-ether)	Right	200, 90	164, 84	220/112	84	108	84	68	40
No. 6—R. E., male, 37. Dx: Hyper. with c-v Dis. Surg: Left Coel. gang. (N <sub>2</sub> O-ether)	Left	250/170 205/144	238/164	61	74	102	110	30	Apnea

creased in other experiments but were consistent for any one patient. Respirations were characterized by an immediate and transient apnea followed by a polypnea or occasionally a decrease in the rate of respiration. The apnea most commonly occurred in the inspiratory phase.

The intact greater splanchnic nerve and the central end of the severed nerve were

Examinations of serial electrocardiogram of Lead II taken simultaneously with blood pressure recordings and before and after faradic stimulation of the celiac ganglion revealed the following significant findings. These were noted in only five of twenty-two ganglionic stimulations. The changes in heart rate, as noted above, were consistent for any one patient and showed an in-

significant increase or decrease. However, arrhythmias were frequent, being of the sinus type or characterized by auricular or occasionally ventricular premature beats. Auricular-ventricular dissociation occurred twice. Split P waves and slurring of the R complex were also noted. An elevation of the S-T segment (3 mm.) was seen twice with the use of a strong faradic current. T waves were frequently inverted, widened and increased in height.

#### REMARKS

The upper abdominal viscera receive a dual autonomic nerve supply chiefly via the vagal nerve and the sympathetic fibers along the celiac plexus. The application of stimuli directly at the concentration of autonomic fibers at the celiac plexus is a logical procedure to use in determining the cardiovascular and respiratory effects from abdominal viscera stimulation as it may be observed during surgery. This approach has not been reported among the numerous experiments of various types of stimulations to abdominal organs in man. The results from stimulation of the celiac ganglion in animals have been studied.<sup>1,3,4</sup> This report concerns the results obtained following the direct stimulation of the celiac ganglia in man. The results obtained are not unlike those already reported from similar experiments completed on dogs.<sup>1</sup> Faradic stimulation of the celiac ganglion produced essentially a sympathomimetic response in the circulatory system. This was confirmed partly by obtaining a similar response upon stimulating the central cut end of the greater splanchnic nerve. There was a rise in systolic and diastolic blood pressure, in both man and dog. The elevations in blood pressure in the patients used in this study were not marked. This was probably due to the presence of a vascular disturbance with hypertension already present in some of the patients. Notwithstanding the close proximity of the vagal fibers in the region of the celiac plexus, bradycardia or other signs of vagal stimulation were seldom seen. Significant electro-

cardiographic changes were noted in only five of twenty-two experiments. However, it is presumed that some degree of vagal stimulation was manifest to account for the absence of tachycardia and of a decrease in pulse pressure and for the appearance of some of the electrocardiographic changes. While it is accepted that a dual autonomic innervation is normally balanced, it is quite probable that in the abdomen, the tonus of the sympathetic fibers is greater than that of the vagus and hence more susceptible to stimuli. In the thoracic region there is reason to believe that the reverse may be true. Thus, upon stimulation in the celiac plexus region, while both vagal and sympathetic fibers may be irritated, the effects from the latter predominate.

Significantly enough, no fall in blood pressure occurred in any of the patients upon stimulating the celiac ganglion, although such an effect occasionally was seen in the dog. It has been our clinical experience that manipulation of upper abdominal viscera under general anesthesia may produce a sudden reflex-like fall in arterial and pulse pressures with no significant change in heart rate.<sup>5</sup> In this instance, it is possible that stimulation of the abdominal vagus and its subsequent dromotropic as well as chronotropic effect upon the heart have overshadowed the influence of the sympathetic fibers. We have not yet been successful in obtaining an electrocardiogram at the time of such reflex vascular depression from visceral stimulation to fortify this contention. Another mechanism that may play a rôle here, may be a reflex vasodilator response involved by visceral afferent stimulation. The strength of stimulation determines the necessary threshold.

From a practical point of view, the treatment of vascular aberrations arising from direct celiac stimulation or following the manipulation of abdominal viscera is important. If an undue and dangerous hypertension results, it would seem logical either to remove the stimulus or block the nervous pathway. In the latter in-

stance, application of 1 per cent procaine solution over the celiac ganglion has been tried in several cases and found satisfactory. It is advised for all upper abdominal procedures in which a moderate or severe degree of manipulation of organs is anticipated. If a fall in blood pressure is seen associated with a decrease in pulse pressure and a slow pulse, vagal stimulation or the occurrence of a reflex vasodilator response may be assumed. To remedy this condition, the stimulus may be removed, procaine solution applied to the celiac plexus region or a vasoconstrictor such as ephedrine may be given.

The respiratory phenomenon resulting from faradic stimuli of the celiac ganglia in man are essentially similar to that found in the dog. The decrease in respiratory rate or frequently the occurrence of an apnea followed by a polypnea are the results of a strong reflex upon the respiratory center. These effects are short lived and are generally self-regulated by the chemical stimulation of accumulated carbon dioxide.

#### SUMMARY

During the course of surgery for vascular disturbances, the celiac ganglia in man

were stimulated with a faradic induction coil and the responses noted in the circulatory and respiratory systems.

The changes were characterized by a rise in systolic and diastolic blood pressure, an increase in pulse pressure and a transient apnea followed by a polypnea. Electrocardiographic studies showed arrhythmias with occasional elevation of the S-T segment and widening and inversions of the T wave. The heart rate, *per se*, was not altered significantly.

The mechanisms involved and the clinical significance and treatment of these changes are discussed.

#### REFERENCES

1. MARTIN, S. J., BURSTEIN, C. L. and ROVENSTINE, E. A. Stimulation of the celiac plexus in the dog: 1. Cardiovascular and respiratory effects. *Arch. Surg.*, 44: 943, 1942.
2. BISHOP, L. F. and BISHOP, L. F., JR. A clinical study of the graphic method of recording blood pressure. *Ann. Int. Med.*, 3: 808, 1930.
3. BURSTEIN, C. L. and ROVENSTINE, E. A. Circulatory disturbances reflexly inaugurated by stimulation of the celiac plexus. *Arch. Surg.*, 35: 599, 1937.
4. LAIGNEL-LAVASTINE, M. J. *de psychol. norm. et path.*, 4: 216, 1907.
5. ROVENSTINE, E. A. and MARTIN, S. J. Cardiovascular equilibrium during anesthesia. *Indiana M. J.*, 34: 201, 1941.

# Case Reports

## FRACTURE OF THE LESSER TUBEROSITY OF THE HUMERUS

S. L. HAAS, M.D.

Diplomate of the American Board of Orthopedic Surgery;  
Chief Surgeon, Shriners Hospital for Crippled Children

SAN FRANCISCO, CALIFORNIA

**F**RACKTURE of the lesser tuberosity of the humerus, unassociated with other fractures or with a dislocation of the

muscle has a very broad attachment to the lesser tuberosity and is inserted into the capsule of the shoulder joint, distributing



FIG. 1. Roentgenogram showing fracture of the lesser tuberosity.  
The fragment is rotated and displaced a greater distance than  
in the roentgenogram.

shoulder joint is an infrequent injury. There are several reasons for the rarity of this lesion. From an anatomical standpoint, the lesser tuberosity is not very prominent and its position on the medial side of the head of the humerus is protected from direct injury. The subscapularis

its lines of force over a wide area with a short range of motion. The normal major function of the subscapularis muscle is to rotate the arm inward strongly and to adduct the arm when it is lifted about sixty degrees lateralward. The greatest force exerted by the subscapularis would occur

when a strong external rotatory and abduction force was applied at a time when the arm was in the position of maximum exter-

adduction will allow the fragment to approximate its position on the humerus and union will take place. Direct force

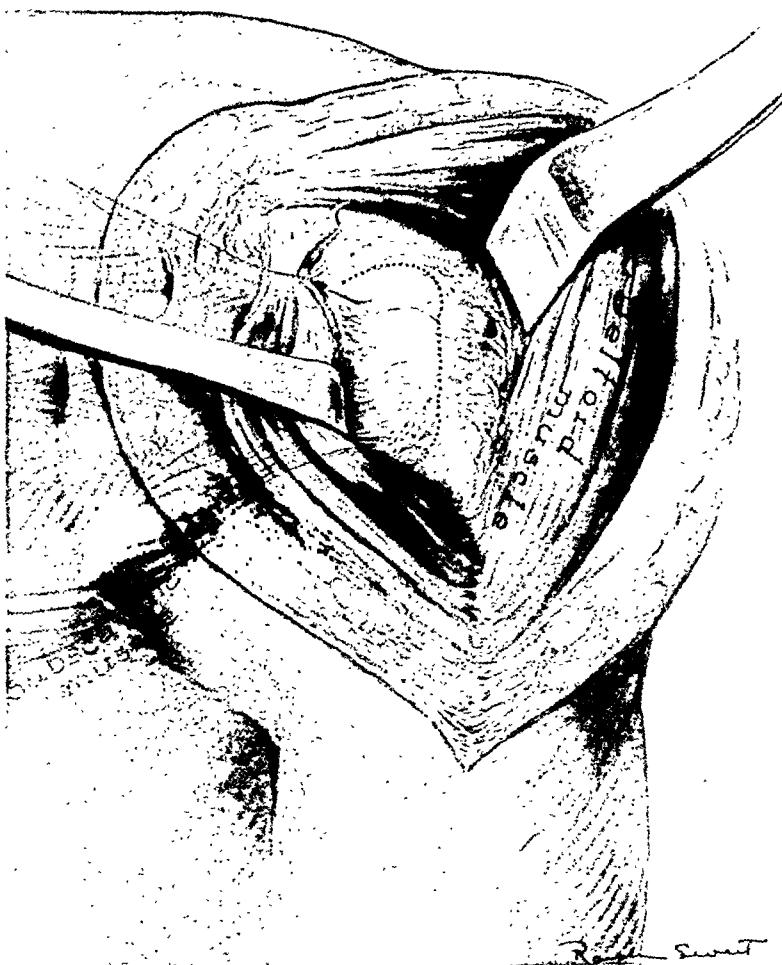


FIG. 2. Drawing shows approach to fracture of the lesser tuberosity of humerus. Notice cut through the short head of biceps to allow better exposure of fragment which will be pulled down and in by the subscapularis muscle.

nal rotation and about sixty degrees of lateralward abduction. It is apparent that this opportune combination of events would not be present very often, and because of the other anatomical factors the possibilities for a fracture or avulsion of the lesser tuberosity alone would be very small.

We find very little data on methods of treatment for fracture of the lesser tuberosity and most authors pass it over with a few casual remarks. It is possible if the distraction is not too great that a manipulation of the arm in internal rotation and

cannot be applied to the fragment because of its deep seated position. If the fragment is not reduced, the strength of the involved upper extremity of the shoulder joint would be weakened. Furthermore, there is the possibility of restriction in motion and a painful shoulder due to impingement of the loose fragment on the rotating head. There may also be a tear of the capsule which may predispose for dislocation of the head of the humerus.

After considering all of these facts it is believed that operative interference is warranted, in any case in which the frag-

ment is not in close approximation to its normal position. The method of operation will be described in the report of a patient with a fracture of the lesser tuberosity.

Several attempts were made to reduce the fracture but were unsuccessful, after which, operation was decided upon.

Operation was performed on April 15, 1942,



FIG. 3. Roentgenogram two months after reduction. There is some calcification in the tendon of the subscapularis muscle.

#### CASE REPORT

The patient, W. T., a white male, age thirty-three, was referred by Dr. George Cox. He gave a history of having fallen on April 9, 1942, while descending a flight of stairs. He did not know the position of his arm when he struck the floor. There was considerable pain and swelling in the region of the shoulder joint. The roentgenogram revealed a fracture of the lesser tuberosity and the fracture surface was rotated away from its normal position. (Fig. 1.) When seen the next day, the swelling had increased. The arm was held to the side, abduction was resisted and painful when forced. Internal rotation was fairly free and only slightly painful, but external rotation was quite painful and restricted.

under a general anesthetic. An incision was made along the outer end of the clavicle curving down along the inner margin of the deltoid muscle. The approach was quite similar to that of Sever's for release of the subscapularis muscle in obstetrical paralysis, but a little wider exposure was utilized. The dissection was carried down through the fat and fascia to the margin of the deltoid muscle which was then undermined and retracted lateralward. (Fig. 2.) The coracoid process of the scapula was located and the short head of the biceps and coracobrachialis insertions were exposed. The tendon of the short head of the biceps muscle was severed below the coracoid process. A considerable mass of clotted blood in the underlying tissue was removed and the dissection carried

downward and inward until the fragment of the lesser tuberosity was located. The fragment was turned over on itself and was pulled down and

and fixed in place with a Valpeau type of bandage.

On April 27th, twelve days after the opera-



FIG. 4. Range of abduction and external rotation.

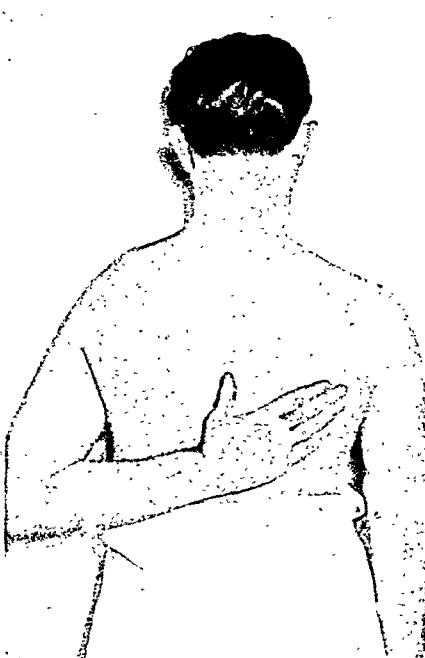


FIG. 5. Range of internal rotation.

ward by the contracted subscapularis muscle. He bed from which the fragment was torn on the humerus was then exposed, and in the immediate vicinity a hole in the capsule of the shoulder joint was found. The torn fragment was reduced and placed in its normal position. Two holes were bored through the torn off piece of bone and two holes in the humerus, after which heavy silk sutures were passed through the corresponding holes in the fragment and humerus, fixing the fragment in its normal relation to the head of the humerus. Supplementary sutures were placed extending from the subscapularis tendon to the capsule. The tear in the capsule of the shoulder joint was closed with heavy silk sutures. These latter sutures came close to the bicipital groove, but care was taken not to include the tendon of the long head of the biceps. The severed section of the short head of the biceps was sutured with silk and the wound closed with chromic catgut for the deep layer and silk for the skin. The arm was placed in internal rotation and adduction

tion the arm was placed in a sling, but at night an additional circular bandage was applied about the chest. Gentle daily abduction exercises were started with gradual increase in range of motion. Later external rotation was instituted, being quite guarded up to the sixth week. Heat therapy, stretching, passive and active movements were applied and there was a gradual increase in strength of the muscles and range of motion at the shoulder joint. The last few degrees of external rotation were the most stubborn to overcome. The patient ultimately attained a full range of motion with normal strength, and subsequently he passed the physical examination for the Ski Troop. (Figs. 4 and 5.)

#### CONCLUSION

Fracture of the lesser tuberosity by itself is an infrequent injury. Operative restoration is the method of choice in order to obtain a full painless range of motion with normal strength of muscle control.



# ECTOPIC PREGNANCY

## GESTATION OF EIGHT MONTHS—RETAINED EIGHT YEARS

HARRY L. DENOON, JR., M.D.

AND

W. CAREY HENDERSON, M.D.

Chief of Surgical Service,  
Northampton-Accomack Memorial Hospital

Associate Surgeon,  
Northampton-Accomack Memorial Hospital

NASSAWADDOX, VIRGINIA

FROM the opening paragraph of that excellent monograph, "Extra-Uterine Pregnancy," by Dr. Edward A. Schumann we read as follows: "The history of the recognition of pregnancy proceeding outside the cavity of the uterus, the gradual understanding of its gravity and the development of modern methods of its treatment, forms one of the most fascinating episodes in that epitome of human intellect, its brilliancies and its lamentable failures, the history of medicine."

### CASE REPORT

A colored woman about forty years of age expected to be delivered in August, 1935. She had had cessation of menses, abdominal enlargement, and had felt fetal movement. Progress had seemed normal. In August, 1935, however, movements had ceased and soon afterward she began to menstruate regularly but too freely. In February, 1936, she was seen by one of us (H. L. D.). Her abdominal tumor was noted to be the size of full gestation but there was no movement and no sounds were heard. Pelvic examination showed a chronic cervicitis with no dilatation or softening. She was considered to have a dead pregnancy or a fibroid tumor or both. She was advised to have a laparotomy as the safest method of delivery. Her family agreed and she promised to return the following week but failed to do so.

She was next seen in March, 1943, under a different name, referred by a different family physician, and for another condition. There was, therefore, a lapse of several days before the two admissions were found to be of the same person. At the time of the more recent admission she presented a typical picture of partial high intestinal obstruction of five days' duration. There was soft distention in the upper abdomen but a hard, somewhat irregular tumor, estimated to be the size of a seven or

eight months' pregnancy, arose in the lower left quadrant. She told us that we had advised her to have a "tumor" removed in 1936 but she had gotten on so well, being able to work every day, that she had failed to return. The tumor had not increased in size, and no periods had been missed until one month ago, and to this she gave no significance. It was only when the family was called in for consultation that connection between this and the previous admission was established. Use of Wangensteen suction, intravenous fluids, and mild sedation gave temporary relief for forty-eight hours prior to laparotomy.

The tumor was ovoid and appeared to arise from the region of the left broad ligament. It shelled away with fair ease from the anterior wall. There were numerous points of attachment of the small bowel to the tumor, one of which was definitely constricted. These attachments were freed with little damage to the bowel. Adhesions were freed to a very narrow base. The left tube could not be identified and no left ovary was found. As the pedicle of the tumor was well away from the uterine fundus we considered the tumor as arising from the left ovary. The leathery coating was impregnated at numerous points with calcium deposits.

Within the membranous envelope we found a fetus of an estimated eight months' gestation tightly compressed and molded on itself. Its outside surface and the inside surface of the sac were dry and waxy, separating readily. There was a thin, evenly distributed layer of short soft black hair between the fetus and the sac. The dried up cord ran to placental remains firmly attached within the sac. The fetal soft parts while very dry were not calcified.

### COMMENT

Kuchenmeister, in 1881, designed a classification of retained extrauterine pregnancies which clarifies the subject enormously. The first type is best illustrated by

our own case which he would call a *lithokelyphos* since the calcification was limited to the membranes or the fetal sac. He suggests that the sac sets up a low grade irritative peritonitis giving rise to a fibrinous exudate covering the walls of the sac and eventually undergoing calcareous degeneration. His second type he terms *lithokelyphopiedion* and applies this name when both membranes and sac are involved in the calcareous process. The third type is the true *lithopedion* in which the fetal body is chiefly affected. Here the membranes are less definitely differentiated and removal entails greater trauma to the peritonealized structures to which they are attached. One of us (W. C. H.) had the pleasure of watching the late Dr. A. Murat Willis, of Richmond, Virginia, remove a true lithopedion from the abdominal cavity of a colored woman where it had remained for sixteen years. On contact with outside air layers of calcified material dropped away from the body of the fetus.

For those who are interested in the historical aspects of this class of cases we would suggest the monograph of Schumann referred to above. Beginning with the case observed by Albucasis about the middle of the eleventh century and recorded by Francisco Rousetti he shows how the earliest cases were diagnosed only when they ulcerated through the abdominal wall. Jacob Nufer's abdominal section on his own wife in 1500 and recorded as the classical first case of cesarean section suggests the possibility of abdominal pregnancy. It was stated, "He opened the abdomen so cleverly at the first incision that the child was safely extracted." Only in 1594 did Primrose deliberately remove the first recognized abdominal pregnancy.

Progress was made with time as indicated by the report in 1913 by Dr. J.

Shelton Horsley who, following a case of his own, had records of 138 extrauterine pregnancies with living child at or near term. Lash noted pre-eclampsia with an abdominal pregnancy.

Human frailty looms large in the picture, however. As with us, so with others, patients do not always follow our advice and with the years comes calcium. Otell, in Washington, D. C. records a case of a retained fetus of forty years' duration removed at autopsy in a woman of seventy-five who died of other causes. Titus and Eisaman, of Pittsburgh, present a beautiful diagnostic study of a fetus retained for forty years. DeLee stated that "Wagner had a case where a mummified fetus was carried for 29 years and Virchow one for 28 years. Smith describes a calcified fetus which was removed from a woman 94 years old, 60 years after conception." Cullen had one at Johns Hopkins retained three years, Hayd's case was of thirty-three years' duration, and others of similar durations.

We present our case to add to the statistical study of a rather unusual condition.

#### REFERENCES

1. CULLEN, T. S. Unusual cases illustrating points in diagnosis and treatment. *Surg., Gynec. Obst.*, 20: 260, 1915.
2. DELEE. Principles and Practice of Obstetrics.
3. HAYD, H. E. Litho-kelyphopiedion. *Am. J. Obst.*, 56: 657, 1907.
4. HORSLEY, J. SHELTON. Abdominal, or extra-uterine pregnancy with living child. *Surg., Gynec. & Obst.*, pp. 676-768, December, 1913.
5. LASH, A. F. Pre-eclampsia in an abdominal pregnancy. *Am. J. Obst. & Gynec.*, vol. 23, 1932.
6. OTELL, LAWRENCE S. Report of a case of lithopedion carried for forty years. *Am. J. Obst. & Gynec.*, vol. 23, 1943.
7. SCHUMANN. Extra-uterine Pregnancy. New York, 1921. D. Appleton & Co.
8. TITUS, PAUL and EISAMAN, JR. "An eight months' extra-uterine pregnancy calcified and retained for forty years. *Am. J. Obst. & Gynec.*, vol. 23, 1932.



# HERNIAS

## REPORT OF TWO UNUSUAL CASES

CAPTAIN MILTON N. CAMP, M.C. AND MAJOR SHERMAN E. ANDREWS, M.C.  
Station Hospital  
CAMP POLK, LOUISIANA

PATIENTS with hernias are being hospitalized in large numbers on all surgical services associated with preparing our men for the present emergency. The increased frequency of these patients affords most hospitals the opportunity to have much variation in the types treated. This report presents two cases of unusual hernias, namely, left superficial interparietal inguinal hernia, and bilateral direct inguinal and femoral hernias.

An interparietal inguinal hernia is an uncommon type located in the inguinal region lying between layers of the abdominal wall. Fuld,<sup>1</sup> and Lower and Hicken<sup>2</sup> have anatomically classified them as follows: (1) Properitoneal inguinal hernia; the sac lies between the transversalis fascia and the peritoneum; (2) interstitial inguinal hernia, the sac lies between two abdominal muscles; and (3) superficial inguinal hernia; the sac lies between the aponeurosis of the external oblique muscle and the integument. Statistics are not available giving the incidence of these hernias.

The following case illustrates the superficial variety of interparietal inguinal hernia with the sac being located between Camper's and Scarpa's fascias.

### CASE REPORT

CASE 1. A. S. H. No. 18472, a twenty-six year old, white soldier was admitted June 24, 1942, with an atraumatic history of a mass the size of a lemon in the left lower quadrant of three months' duration. The lump usually made its appearance while he was walking and generally disappeared on lying down. At irregular intervals the enlargement was tender but on the admission date this symptom was more pronounced than usual, causing him to seek medi-

cal attention. The patient had always had an undescended left testicle.

Physical examination revealed a moderately well developed and nourished white soldier in no apparent acute pain with a mass in the left inguinal region the size of a large lemon. The disorder was above Poupart's ligament opposite and above the external inguinal ring which admitted the index finger with slight difficulty. The hernia was tense, slightly fluctuant, moderately tender and non-reducible.

Immediate surgery was thought advisable and at operation a hernia was found that had dissected itself upward from the external inguinal ring between Camper's and Scarpa's fascias for a distance of two inches. The hernial sac contained incarcerated omentum, testicle, and fluid, all of which were released when the external oblique fascia was separated down to the external inguinal ring. A moderate varicocele accompanied the spermatic cord involving largely the posterior vein group. Two-thirds of the varicocele was removed and the hernial sac excised at its neck after placing a purse-string suture. The distal portion of the sac was sutured about the testicle performing a "bottle operation." Preoperatively the soldier had repeatedly requested that his testicle not be removed so it was placed and fixed just below the os pubis in the upper scrotum after reconstructing a new floor for the spermatic cord with the conjoined tendon and Poupart's ligament. Slight lengthening of the cord had been obtained by the varicocelectomy and the vas deferens was partially mobilized in a manner similar to that described by Brunkow.<sup>3</sup> The external oblique fascia was closed over the cord structures.

The postoperative course was uneventful with the soldier being discharged in thirty days and he was performing his military duties satisfactorily with no complaints four months later.

The incidence of both inguinal and femoral hernias in the same patient is

infrequent. Jason<sup>4</sup> lists in his series one case of bilateral indirect inguinal and femoral hernias and two cases of right (not classified) inguinal and femoral hernias. Annandale<sup>5</sup> reported a case of reducible unilateral indirect and direct inguinal and femoral hernias.

CASE II. V. L. W. No. 29336, a twenty-six year old, white soldier was admitted January 14, 1943, with an atraumatic history of vague pain in the right lower quadrant for six years. He was hospitalized for elective correction of his hernias.

Physical examination revealed a moderately well developed and nourished white soldier in no distress with right complete inguinal and femoral hernias and left incomplete inguinal and femoral hernias.

A three-inch, curved incision was made beginning above and parallel to the right Poupart's ligament curving downward over the femoral ring. The direct hernial sac had a base one and one-half inches wide and protruded the same distance. This sac was opened and by blunt dissection the femoral sac, measuring one inch by one inch, was peeled into the direct sac which was purse stringed at its base. The stump was fixed beneath the right internal oblique muscle. The femoral ring was narrowed by placing interrupted sutures between Poupart's ligament and pectenous muscle and fascia. The direct portion of the hernia was repaired by suturing

the conjoined tendon to Poupart's ligament and closing the external oblique fascia over the cord.

The soldier was discharged to duty after thirty days of uneventful convalescence, returning one month (two months postoperatively) later with an acute right epididymitis but it seemed rather late for a complication of this type to follow his surgery. For the past four weeks the soldier has been performing full military duty, being free of all symptoms.

The left inguinal and femoral hernias have not been operated upon because they are incomplete and asymptomatic.

#### SUMMARY

Two cases of unusual hernias, namely, left superficial interparietal inguinal hernia and bilateral direct inguinal and femoral hernias are reported.

#### REFERENCES

1. FULD, JOSEPH E. Interparietal inguinal hernia. *Internat. J. Surg.*, 34: 132-133, 1921.
2. LOWER, WILLIAM E. and HICKEN, N. FRED. Interparietal hernia. *Ann. Surg.*, 94: 1070-1087, 1931.
3. BRUNKOW, BENJAMIN H. Surgical consideration of the inguinal triangles. *Am. J. Surg.*, 59: 594-597, 1943.
4. JASON, A. N. *Hernia*. P. 1325. Philadelphia, 1941. The Blakiston Company.
5. ARMANDALE, THOMAS. Case in which a reducible oblique and direct inguinal and femoral hernia existed on the same side and were successfully treated by operation. *Edinburgh M. J.*, 21: 1087-1091, 1875-1876.



# PERMANENT URINARY CONTINENCE FOLLOWING PELVIC SURGERY\*

COMMANDER PHINEAS BERNSTEIN, M.C.  
NEWPORT, RHODE ISLAND

**P**OSTOPERATIVE anatomical lesions rarely present a basis for analysis of the etiology for complete urinary incontinence. The bizarre pathological picture found in a patient with this condition is so striking and etiologically problematical that it seems worthy of discussion and recording. Furthermore, it may suggest an additional causative factor for urinary continence pending further experimental proof or clinical evidence.

Urinary retention, while not a clinical rarity, may be attributable to various specific causes. Generally this phenomenon is due either to mechanical obstruction, functional or pathological neurogenous changes or genitourinary tract trauma. Intravesical or urethral neoplasms, anatomical changes, diverticuli as well as extravesical tumors impinging upon the vesico-urethral junction may obstruct urinary flow. Pathological and functional diseases altering the continuity of the cerebrospinal or peripheral arc pathways destroy the micturition reflex and give rise to the "cord" or neurogenic bladder, commonly exemplified in syphilis and diabetes. Concussion, surgical shock, spinal and caudal anesthesias, severe neuroses, prolonged febrile states and cord anomalies, as found with spina bifida, are among the common neurological entities also causing this condition. Urinary tract trauma, incidental to surgery, gravidity, radiation and instrumentation not infrequently precede the cessation of urinary flow.

What rôle the mechanical factor inherent in vesico-urethral angulation and distortion plays in urinary blockage is a moot question which arises in this case. Anatomically and embryologically, the urinary

and genital systems are closely linked. The marked alterations of the former, some, in fact, physiological, which are induced by gravidity, large uterine neoplasms and pelvic inflammatory masses are well recognized. Incidental to these conditions, the increased vesico-urethral angulation and the associated dislocation of the fixed vesical floor present a definite mechanical basis for urine retention. The degree of increased angulation, however, requisite for complete urinary continence is uncertain.

In this patient, a nullipara, a large posterior enterocoele, a small cystorectocele, marked urethral eversion, and an occult spina bifida were found in combination with an upwardly displaced uterus, markedly elevated and fixed in the false pelvis, and a bladder, retracted and adherent to the anterior abdominal peritoneum.

The patient, M. A., age thirty years, married seven years, nulligravida (husband had gonorrhea in 1926. Kahn test negative). Menses were normal in all respects. There was no history of dysmenorrhea.

She had whooping cough, measles, scarlet fever and occasional "head colds." After the first year of married life, she frequently experienced lower abdominal pains and in March, 1941, a "chronic appendix and a follicular cyst of the left ovary" (pathological report) were removed at the Union Hospital in Fall River, Massachusetts. One ampule of amniotic fluid was injected into the pelvis after dense adhesions were separated.

Immediately following operation, urgency, dysuria, and a progressively increasing tenesmus occurred and, during convalescence at home, she developed a profound anxiety state and insomnia on account of a complete urinary continence with severe suprapubic pain and swelling.

\* From the United States Naval Hospital, Newport, Rhode Island.

To overcome the obstruction, a "urethral caruncle" was chemically cauterized and, several times subsequently, Nos. 18 and 20

of the urinary tracts were normal." The obstruction was resected and again reported microscopically as "caruncle."

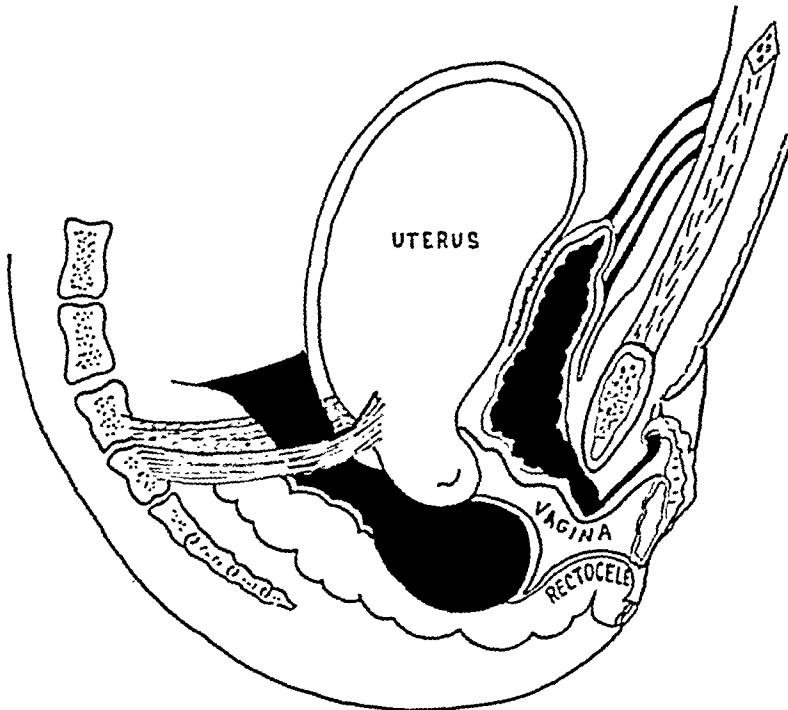


FIG. 1. Ink drawing indicating (in heavy black wash) enterocele, urethral angulation and eversion, high vesicoperitoneal adhesions and elevated vesico-uterine level.

bougies F. were passed. Under spinal anesthesia, at a later date, cystoscopy and retrograde pyelography were twice performed by

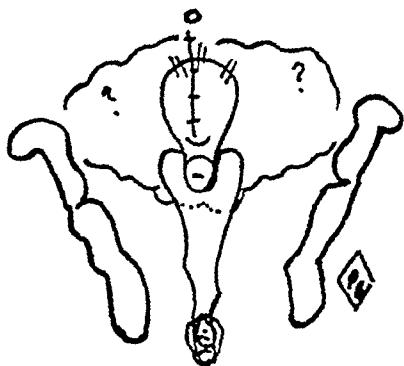


FIG. 2. Pelvic findings on bimanual examinations: ink sketch showing a high, vaguely outlined fundus, confluent with a cystic resistance which completely filled the pelvis, thus elevating vesico-uterine structures.

different urologists, who reported "many inflammatory papillary projections encroaching upon the bladder lumen. Outline and function

still unrelieved, and upon the advice of a midwife, the patient resorted to self-catheterization in squatting position, twice daily, over a period of four months. For the past three weeks, a vaginal "lump" was felt upon exertion or standing.

I examined her for the first time on January 6, 1942; the following physical findings were apparent: She was a well nourished, nervous female, with erect posture and regular body proportions. There were no surface stigmas of disease. Head, neck and chest were well developed, breasts fully matured, heart and lungs were normal. Blood pressure was 118/80. Abdominal examination revealed nothing unusual except a well healed, midline suprapubic scar. Inguinal areas were intact. Superficial and deep reflexes of abdominal wall and extremities were equal and active. Special senses, pupillary and cranial reflexes were within normal range. There were no signs of cerebrospinal syphilis and no saddle anesthesia.

The pelvic examination revealed these significant facts: A nulliparous intact introitus;

relaxed and flaccid perineum; a small asymptomatic cystorectocele; no urethrocele. Upon straining, the urethra rotated forward, outward

polymorphonuclear leucocytes; 14 per cent lymphocytes; 5 per cent monocytes; 3 per cent eosinophiles. The catheterized specimen

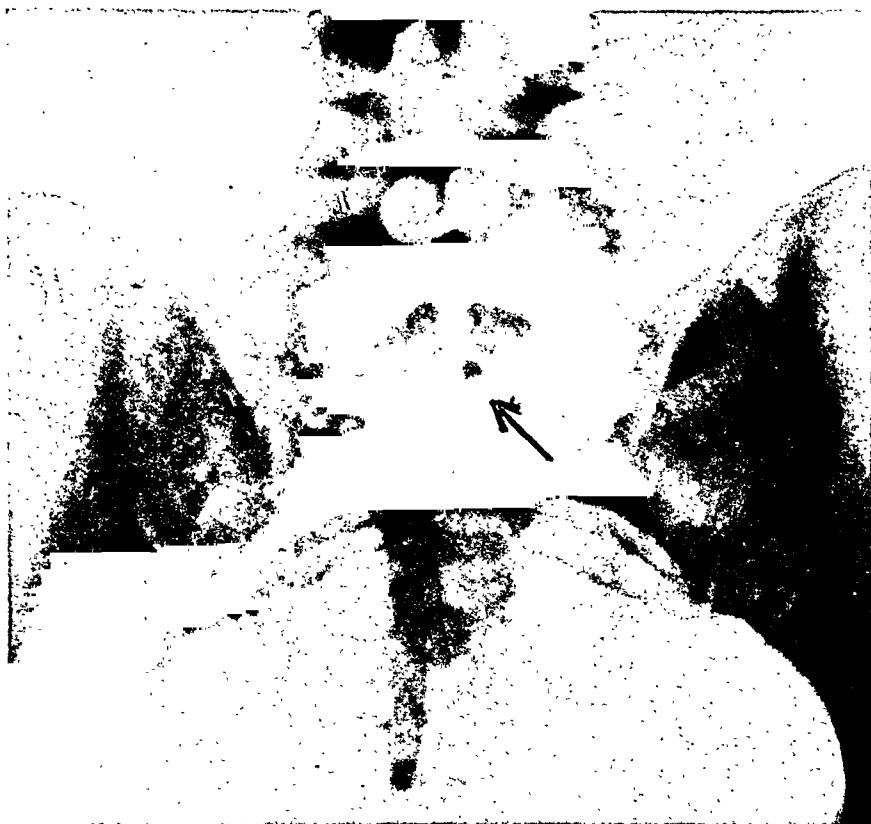


FIG. 3. X-ray indicating spina bifida (arrow).

and upward in a 90° arc, completely everted from its subpubic position. (Fig. 1.)

A posterior vaginal wall enterocele bulged forward voluminously on pressure into the spacious posterior fornix, riding downward over the rectocele eminence. Upon reduction, a gurgling sound was elicited.

The nulliparous cervix was retracted and fixed high up behind the pubis, obliterating the anterior fornix. Pubocervical area felt firm. The fundus, vaguely outlined, seemed ventrofixed about two fingers above the symphysis pubis and confluent with a soft resistance palpable throughout the entire pelvis. (Fig. 2.) The adnexae were not distinguished.

X-ray of the lumbosacral spine showed: "Failure of complete fusion of posterior arc of first sacral segment constituting spina bifida occulta of 4th lumbar vertebra." (Fig. 3.) Intravenous pyelography was not remarkable. Kidney, pelvis and ureteral markings and function were normal on both sides. Blood studies: 5,200,000 red blood cells; 82 per cent hemoglobin; 8,800 white blood cells, 78 per cent

showed specific gravity, 1012; no casts, albumen or sugar, few red blood cells and pus cells and no clumps. The Kahn test of spinal fluid and blood were both negative.

A vaginal repair was advised and also laparotomy, if warranted by pelvic examination under anesthesia. Loss of childbearing function and castration effects incidental to an anticipated complete extirpation were outlined.

On January 16, 1942, under gas-oxygen-ether anesthesia, at the Newport Hospital, Newport, R. I., the pelvic examination confirmed the previous findings.

Following a dilatation and curettage, an anterior colporrhaphy and Kelly urethroplasty were performed with permanent catheter inserted into bladder. (Fig. 4.) The new urethral floor was reinforced by two interrupted No. 2 chromic sutures which incorporated the periosteal tissue overlying the inner margin of the pubic rami. A firm support and urethral fixation were thus completed.

The enterocele exposure required a high triangular mucosal denudation of the posterior

vaginal wall. (Fig. 5.) The sac was separated bluntly from its rectovaginal attachments and was opened, amputated and fixed high up by

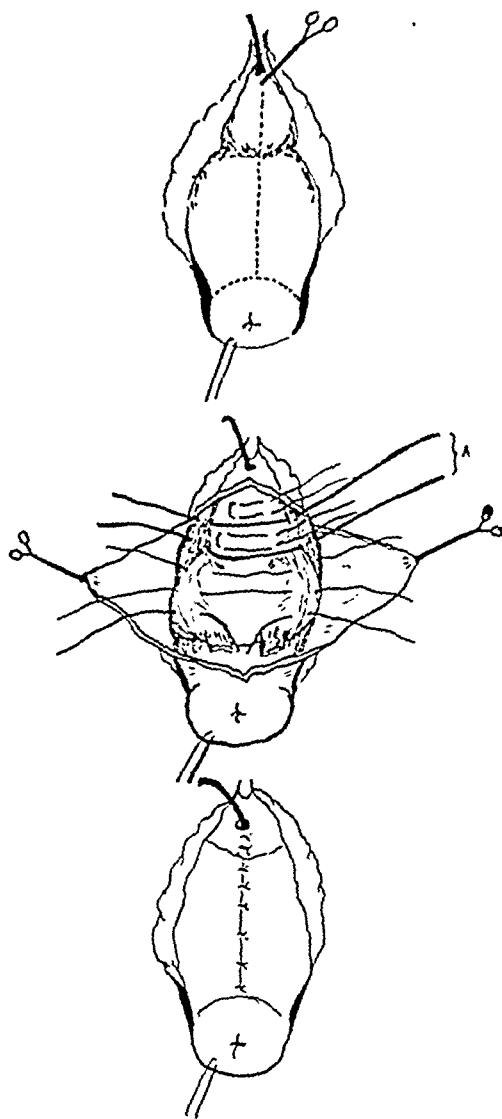


FIG. 4. Ink sketches showing urethrocytostomy repair; mucosal incision, periosteal (A), and Kelly sutures in urethral area; bladder and cervical fixation sutures; and mucosal approximation. Permanent catheter in situ.

a purse-string suture, into the posterior cervix. Obliteration of the retrocervical hernial hiatus was accomplished by several interrupted sutures approximating prerectal fascia to cervix. Levatores ani, deep and superficial perinei muscles were then used to roof the rectocele, forming a moderately high perineum and a three finger introitus.

Through the suprapubic abdominal opening, view of the pelvic structures was completely obliterated by a coalescent mass of variably sized seroceles and adhesions into which the sigmoid disappeared. (Fig. 6.) The bladder, uterus and adnexae were identified after decompression of these cysts, which reached deep into the cul-de-sac and pelvic floor, thus elevating the fundus and bladder to the suprapubic level (Fig. 1) and accounting for the "fixation" of the uterus. The anterior cul-de-sac was obliterated by thickened pubovesical ligaments, adhesions of pubovesical peritoneum and small cysts. Extirpation of the adherent adnexal inflammatory masses necessitated almost complete pelvic floor denudation.

A typical double clamp and double ligature supravaginal hysterectomy and bilateral salpingo-oophorectomy was performed. The sigmoid was used to complete the friable peritonealization. Continuous No. 2 chromic sutures were used for the peritoneal closure and continuous interrupted sutures for the fascia. Heavy silk retention sutures were employed. No drainage was used.

The pathological diagnosis was, "Chronic endometritis, chronic salpingitis with fibrosis and chronic oophoritis with hemorrhagic corpus luteum of both ovaries."

The postoperative course was undisturbed except for mild flushes and sweats, which disappeared after oral administration of 0.5 mg. of stilbesteron daily. On the eighth day, the indwelling catheter was removed. After voiding, bladder retention was less than 50 cc. She was discharged on the fourteenth postoperative day.

Follow-up examinations on April 25th and October 10, 1942, revealed no urethral eversion on straining. The urethral floor was dense and firm and introitus ample. The perineum was moderately high. The posterior and anterior vaginal walls remain up on straining. There was no enterocele. The fornices were soft, cervical stump movable and high, vaginal depth normal and no tenesmus. Menopause symptoms persisted but were well controlled by stilbesteron. The patient felt very well and had resumed work. There were no urinary symptoms; continence was cured.

#### COMMENT

In nulliparous women a spina bifida may be the cause of weakness or hernia of the

pelvic floor. This congenital closure defect of the spine may be accompanied by varying degrees of atrophy in nerves supplying

(March, 1941), in which pelvic adhesions were separated and one ampule of amniotic fluid was injected. Our laparotomy find-

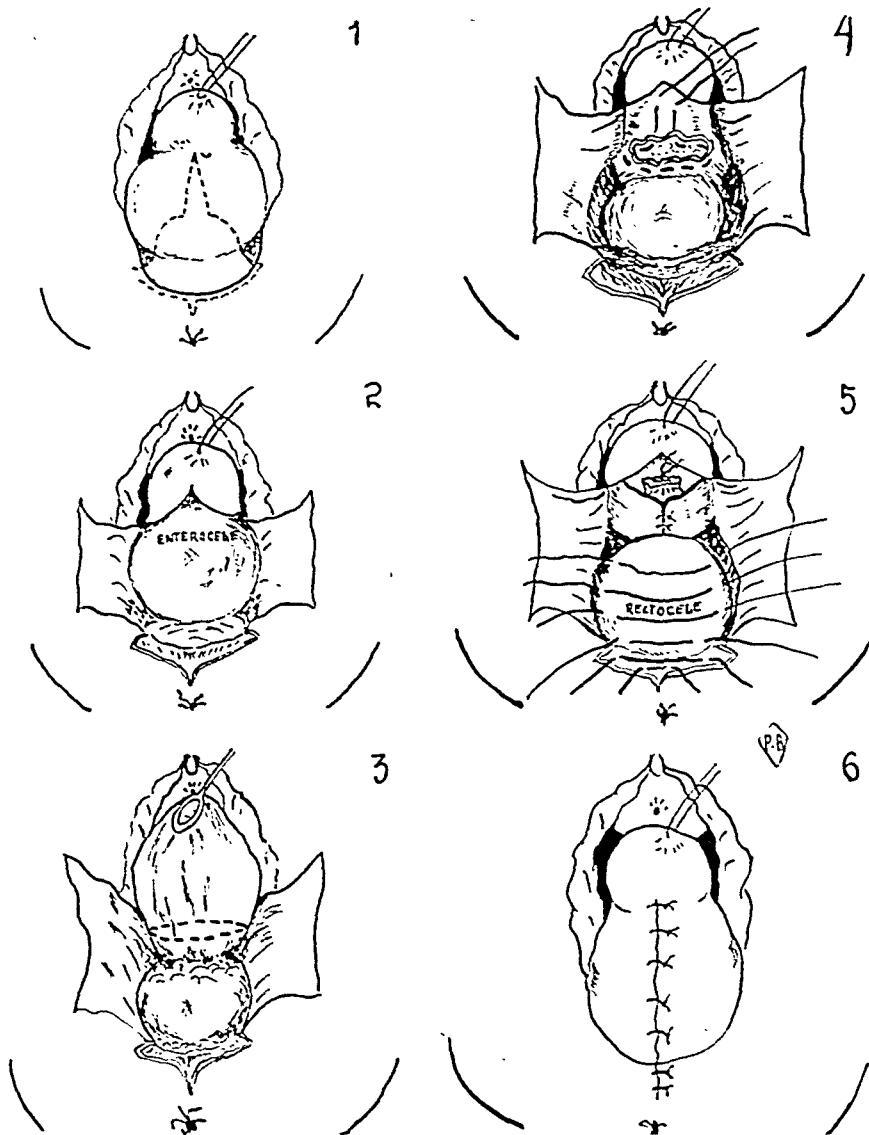


FIG. 5. Ink sketches depicting steps in posterior vaginal wall repair; (1) high triangular mucosal denudation; (2) exposure; (3) separation; (4) purse-string ligation; (5) cervical fixation of enterocoele sac with closure of extravesical hernial orifice, rectocele repair, and (6) perineal and mucosal closure.

the pelvic musculature. Under conditions of strain or the use of force, such as observed in uterine contractions, fecal or urinary tenesmus, lifting or overexertion, the atonic pelvic floor may give way, producing a procidentia of pelvic structures.

Briefly resumed, the onset of urinary continence in this patient occurred while still in the hospital after the operation

ings, namely, the diffuse pelvic serocele inflammation and the upward retraction of the bladder and uterus, it is reasonable to assume, began to develop during this interval as manifested by postoperative onset and bladder symptoms.

The acute vesico-urethral narrowing, attenuation and compression was due to the traction of the completely everted urethra (produced by tenesmus associated with

urethral structure weakness incidental to congenital spina bifida) upon the retracted and adherent bladder fundus (due to

der, and (3) the downward pressure exerted by the bony symphysis against the vesico-urethral junction.

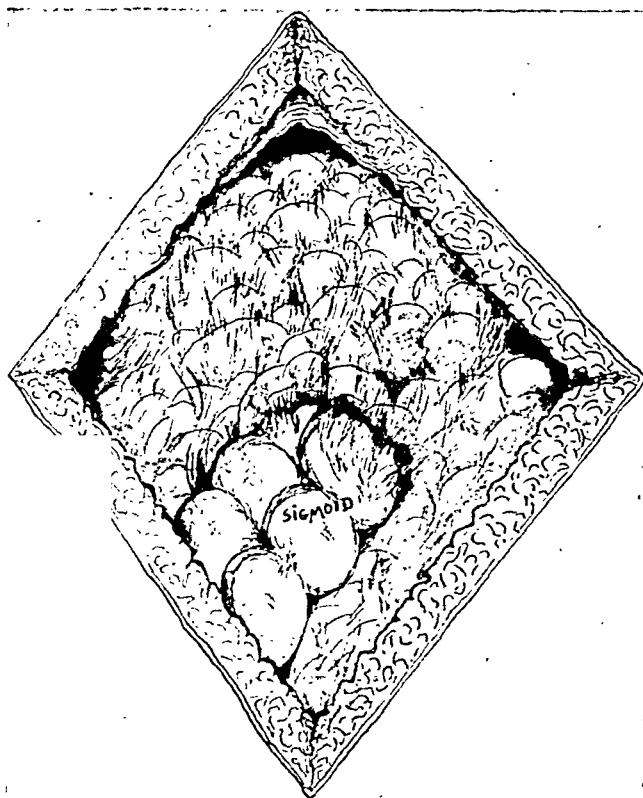


FIG. 6. Ink drawing of pelvis through laparotomy opening; note complete obliteration of genitalia and terminal colon by diffuse serocele formation and adhesions.

amniotic fluid? and adhesions). Manifestations of hernia (enterocele) and increased pelvic floor weakness (urethral eversion and moderate cystorectocele) resulted from the marked tenesmus during the postoperative period.

The explanation of complete urinary continence, based upon the pelvic and vaginal findings in this patient, would seem to depend upon four anatomico-mechanical factors directly involving the vesico-urethral junction: (1) acute angulation, (2) eversion, (3) fixed pressure from the symphysis pubis and (4) the traction exerted upon this area by the urethral eversion counteracting the high vesical fixation.

During micturition, the active forces applied to the bladder neck are (1) outward traction by the evertting urethra, (2) upward traction exercised by the fixed blad-

#### CONCLUSION

The problem of bladder dysfunction has interested gynecologists for a long time.

This analysis of the dynamics, the neurological and anatomical features of urinary dysfunction presents clinical evidence of an additional cause for bladder incompetency, namely, vesico-urethral angulation caused by opponent forces of traction and pressure, due to postoperative pelvic adhesions and pelvic floor weakness and hernia.

While permanent urinary continence such as found in this patient is in itself rare, the factors taking part in its mechanism are probably identical with those of its more frequent counterpart, urinary incontinence, the absolute causes and cure of which are still uncertain. For this reason, the information derived from this study may be of some value.

# RIGHT TRAUMATIC DIAPHRAGMATIC HERNIA

JOHN ROBERTS PHILLIPS, M.D.  
Diplomate of the American Board of Surgery  
HOUSTON, TEXAS

HERNIATION of the abdominal viscera into the right hemithorax is unusual. This case represents very many interesting things:

phragmatic hernia on the right side since the time of his injury.

X-rays revealed a separation of the diaphragm from the anterior chest wall through



FIG. 1. Numerous loops of small intestine are seen in the right lower chest cavity. The outline of the diaphragm is not visualized.

The patient was a white male, age 35, who had had an automobile accident eleven years before. At that time he had suffered a fracture of his spine and had a laceration of his diaphragm, but he had recovered from this serious accident and had carried on fairly satisfactorily for a period of eleven years. Recently, however, there have been attacks of abdominal pain, crampy in nature, associated with nausea and vomiting which led one to believe that he probably had an intermittent intestinal obstruction. He had known that he had had a dia-

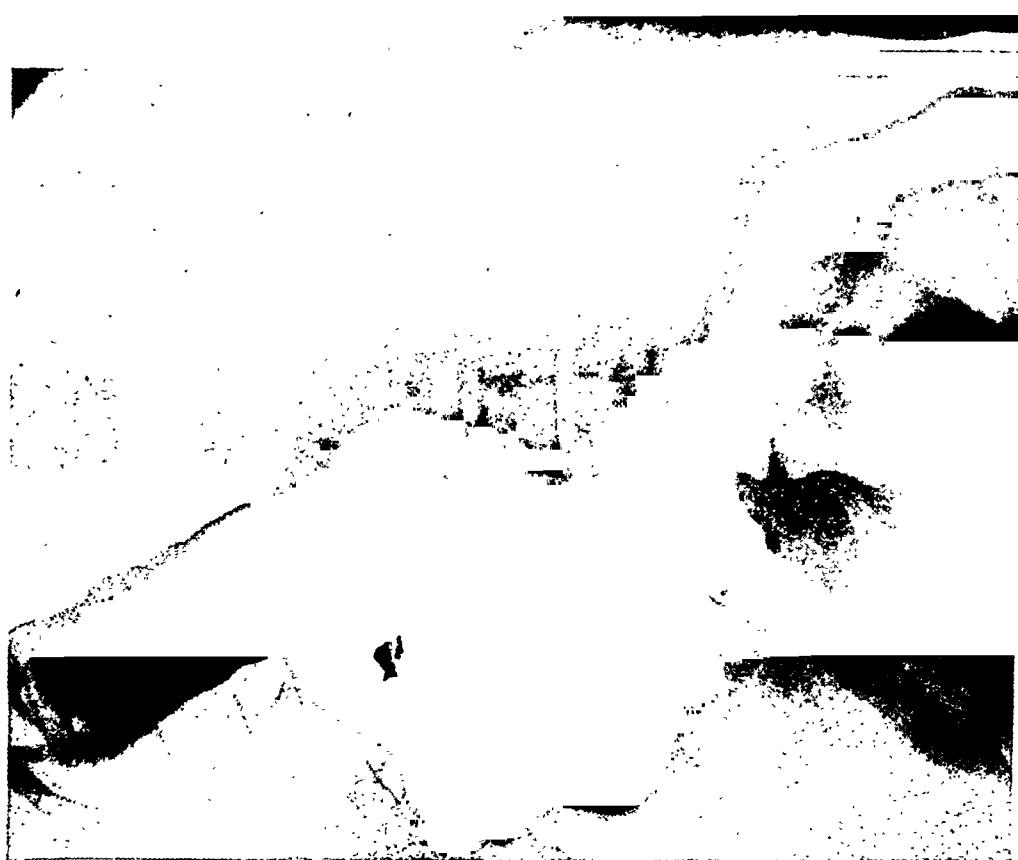
which protruded the ascending colon, stomach, cecum, appendix and loops of ileum. His general condition was quite normal. Operation was advised and because of the anterior location of the rent in the diaphragm, an anterior abdominal approach was decided upon. Under intratracheal anesthesia a high right rectus incision was made, and it was found that the right leaf of the diaphragm had been torn from the chest wall, starting at the xiphoid and extending well around to the mid-axillary line. The diaphragm just dropped posteriorly.



FIG. 2. Barium filled colon shows the entire right colon and most of the transverse colon with loops of small intestine extending into the right hemithorax.



FIG. 3. Shows the lung completely re-expanded on the thirty-sixth postoperative day. Outline of the diaphragm was well visualized.



Through this opening the transverse colon, ascending colon, ileum and stomach herniated into the chest cavity as high as the apex of the

tinum. This was separated and replaced. The diaphragm was then resutured to the anterior chest wall, using catgut and fascia lata stitches.



FIG. 4. The thirty-sixth postoperative day shows the barium filled colon and stomach well below the diaphragm.

chest. The lung was about two-thirds compressed. The round ligament and falciform ligament of the liver had been completely torn, so that the left lobe of the liver was lying in the right lower quadrant, the liver having rotated into this position. When the liver dropped down, of course, this enabled the other abdominal viscera to get through the opening readily in the diaphragm. The abdominal viscera could readily be replaced in the abdominal cavity with the exception of the duodenum, which was adhered along the medias-

The liver was replaced in its normal position and sutured up over the rent to act as a buffer. The falciform and round ligaments were reconstructed. The procedure worked out very well. The abdomen and chest were closed without drainage.

The patient stood the operation well and had, with the exception of an accumulation of some fluid under the skin flap, almost an uneventful convalescence. X-ray of his chest and abdominal viscera three weeks after operation revealed the viscera to be in normal relation in

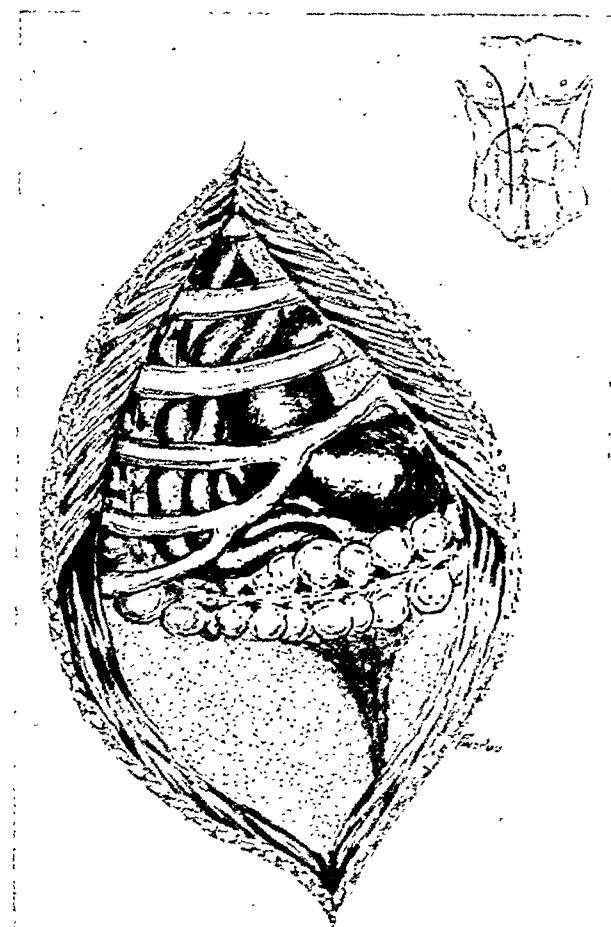


FIG. 5. The type of incision utilized and the position of the abdominal viscera in the right chest cavity.

the abdomen. He is eating well and his general condition is excellent.

This is the second traumatic diaphragmatic rupture that I have repaired within the year. The other occurred on the left side, and was a laceration of the dome, through which the spleen, transverse colon

and loops of small bowel were herniated into the left chest cavity. This laceration was repaired by transcostal approach, suturing the diaphragm from above.

Each case is an individual one and the type of incision for exposure will depend upon the location.

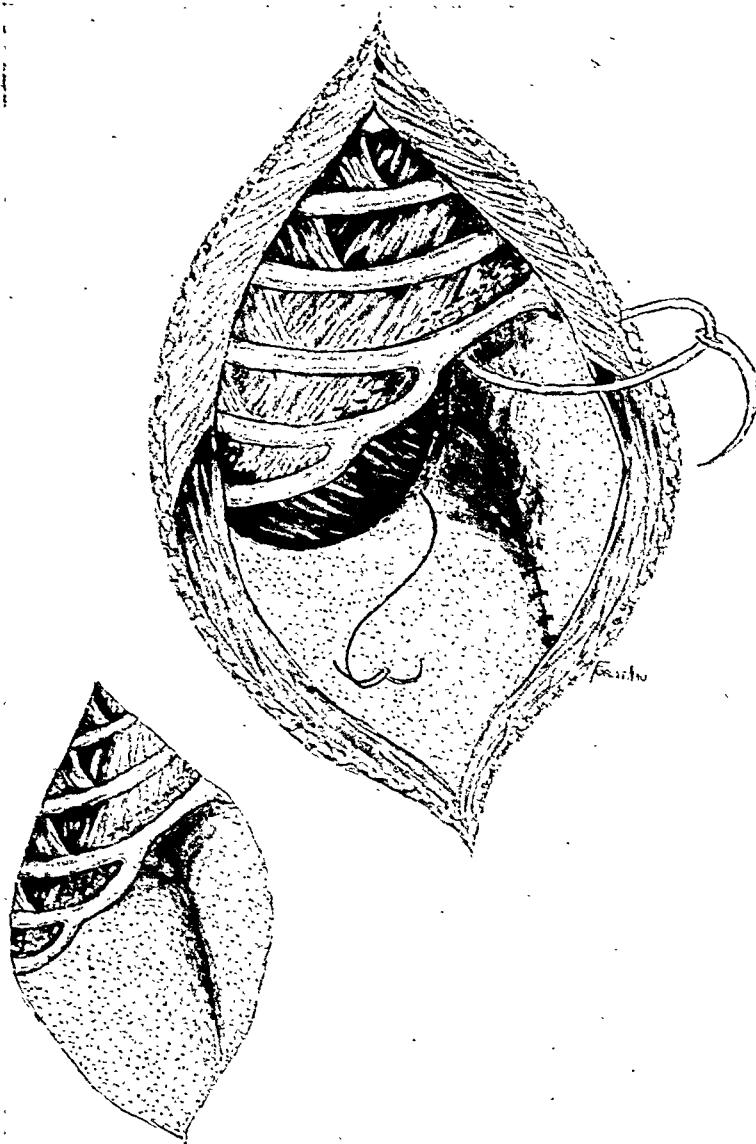


FIG. 6. The method of suture of the diaphragm to the chest wall by through-and-through suture is shown.



# POSTPARTUM HEMATOMAS

## REPORT OF FOUR CASES

SAMUEL LUBIN, M.D.

AND

IRVING HOROWITZ, M.D.

Director, Department of Obstetrics,  
Cumberland Hospital

Assistant Visiting Obstetrician,  
Cumberland Hospital

BROOKLYN, NEW YORK

THE subject of postpartum vulvar and paravaginal hematomas has evinced only passing interest among students and practitioners of obstetrics. This hemorrhage into the soft tissues surrounding the birth canal may be so extensive as to cause severe shock, and if unrecognized or improperly treated, may even result in death. The literature on this subject is relatively meager, although one notes occasional references to it. Hamilton<sup>1</sup> was able to collect only 156 cases of postpartum hematomas up to 1940 and added twelve cases of his own to this number.

Reuff,<sup>2</sup> in 1554, gave the first description of the vulvar and perineal types. Baude-locque<sup>3</sup> first diagnosed the subperitoneal variety following labor, and Casaubon<sup>4</sup> reported it in the literature in 1797. Williams,<sup>5</sup> in 1904, collected thirty-four cases of the latter type and reported a case of his own following labor, not associated with lesions of the uterus. DeLee<sup>6</sup> reported an incidence of hematomas of any variety as one in about 4,000 labors. He noted the fact that large hematomas are rare, but that the smaller ones are seen much more frequently, especially when repairing a torn perineum.

Hematomas occurring in and about the birth canal in the parturient may be divided into the immediate and delayed types. The former occurs immediately and may follow spontaneous or operative delivery. The latter occurs later and is due to sloughing of a vessel, usually a vein which has become necrotic as a result of prolonged pressure.

The delayed cases have been known to occur as late as three weeks postpartum. If the hemorrhage occurs external to the pelvic fascia and levator ani muscles, the

perineum becomes distended by the dissecting mass and swelling of the vulval area, usually on one side, will be noted. If the bleeding takes place above the pelvic fascia and levators, or at the base of the broad ligaments, it may extend up into the false pelvis under Poupart's ligament, or even subperitoneally to the kidney and diaphragm. Too vigorous massage of the uterus may result in hematomas in the subperitoneal connective tissue and in the broad ligaments.<sup>7</sup> Toxemias of pregnancy have been thought to be a causative factor of the bleeding tendency, but hematomas have been encountered in normal, spontaneous births in which labor has not been prolonged and there has been no evidence of toxemia. The blood extravasates along the lines of cleavage of the muscles and fascia.<sup>8</sup>

Vulvar hematomas usually appear within a few hours after the completion of delivery. The blood is extravasated before the end of labor and in most cases accumulates as a mass shortly thereafter. In the immediate variety the mass is usually well formed within six to ten hours and, as a rule, is limited to one labium majus. Rarely, the blood mass may appear late in pregnancy or during labor and thus interfere with the descent of the presenting part. In this situation it has been mistaken for a fetal head or placenta *prævia*.<sup>9</sup>

Intense pain is the most prominent symptom if the bleeding occurs around the rectum and bladder, but in other cases, signs of acute blood loss or anemia arouse the obstetrician's suspicion. Inspection of the vulva will reveal a tense, elastic, fluctuating, painful mass covered by a bluish, discolored skin. If no external mass is

found, vaginal examination will disclose a swelling in the paravaginal tissues. The tumor mass may even occupy the ischiorectal fossa and buttock. In the subperitoneal variety, it may be felt between the layers of the broad ligament. Edgar<sup>10</sup> states that in twins a hematoma may follow the birth of the first child and constitute an obstacle to the passage of the second twin.

As soon as the diagnosis is made, active treatment is indicated. If left alone, the patient may succumb to shock from the loss of blood, or to septicemia from the breaking down of the tumor mass with abscess formation. The mass should be opened widely, preferably through the vaginal mucosa, and all clots evacuated. Bleeding points, if found, must be ligated. The cavity is then packed with gauze and counter-pressure obtained by packing the vagina tightly. A T binder may then be applied for compression. Meanwhile supportive measures, such as transfusion of whole blood or blood substitutes, should be promptly instituted.

Prophylactic therapy consists in the proper treatment of the toxemias of pregnancy, as some observers think that a relationship exists between toxemia and postpartum hematomas. Blood dyscrasias or bleeding tendencies should be treated with calcium, vitamin K or small blood transfusions, if necessary. The vulva and vaginal tract should be inspected postpartum for tears and bleeding points, especially at the upper angle of lacerations and episiotomies. An insignificant ooze in this location may terminate within a few hours in a large sized hematoma with accompanying shock.<sup>11</sup> Small hematomas may be carefully watched and treated with ice bags and compression. If, however, an increase in size is noted, they should be treated in the manner outlined above.

Vaux<sup>12</sup> reports a mortality of 12 per cent and Hamilton,<sup>13</sup> in a series of twelve cases, reports a mortality of 8.3 per cent, the one death occurring in a primipara in whom a mass of the left labium was treated expectantly. The mortality in the subperi-

toneal variety is between 50 and 60 per cent. Primiparae are affected a little more frequently than multiparae, and the hematomas occur more often following spontaneous delivery.

A summary of the following four cases of postpartal hematomas is presented. Three of the patients were treated actively and one was treated expectantly. Uneventful recovery followed in all instances.

#### CASE REPORTS

**CASE I.** A twenty-eight-year old white woman, gravida II, para I, with a negative past personal and prenatal history, entered Cumberland Hospital in labor. On June 21, 1941, she was delivered spontaneously of a normal seven-pound, two-ounce infant from the L. O. A. position after six and one-half hours of labor. A second degree laceration was repaired with interrupted No. 2 chromic sutures. Five hours later the patient went into shock. With pressure on the fundus, which was firm and three finger breadths above the umbilicus, a stream of frank blood was noted coming from the vagina. Vaginal examination revealed bluish discoloration of the posterior vaginal wall, the mucous membrane of which was elevated for a distance of about 10 cm. There was an abraded area at the summit of this fluctuant elevation and at this point the mass was opened by blunt dissection. About 300 cc. of blood and clots were evacuated and no bleeding points were noted. Exploration of the cavity disclosed that it extended into the ischiorectal fossa and perianal area. The cavity was packed with ten yards of one-inch and two yards of five-inch gauze, soaked in 1:1000 solution of merthiolate. The vagina was then packed with five yards of five-inch gauze. The patient was given an infusion of plasma, followed by a transfusion of whole blood, and her general condition improved. The vaginal packing was removed in twenty-four hours and the packing in the ischiorectal fossa was removed in forty-eight hours. The patient was discharged from the hospital on the twelfth postpartum day.

**CASE II.** A thirty-two-year old, white woman, gravida II, para I, entered the Prospect Heights Hospital on January 11, 1941. After ten hours of labor she was delivered of a normal six-pound, fourteen-ounce infant from the L. O. A. position by low forceps. A right medio-

lateral episiotomy was repaired. For five hours postpartum the patient experienced lower abdominal pain. Examination revealed that the right labium majus was swollen to the size of a grapefruit and the skin over it was smooth, glossy and bluish. The vaginal canal was distorted by this soft mass adjacent to the right vaginal wall. The episiotomy wound was opened widely and large masses of blood clots were evacuated from the right vulval and paravaginal space. The latter was tightly packed with two strips of one-inch gauze of five yards each. For counter-pressure the vagina was tightly packed with ten yards of two-inch plain moist gauze. The patient was then given a blood transfusion. The vaginal packing was removed in twenty-four hours. The packing in the paravaginal space was removed in forty-eight hours. The patient was discharged from the hospital in good condition on the thirteenth postpartum day.

**CASE III.** A thirty-five-year old, white, obese woman, gravida VII, para VI, with an antenatal history of toxemia, entered Cumberland Hospital and was delivered spontaneously on April 16, 1940, after five and one-half hours of active labor. Several small mucosal tears were noted in the vagina during the second stage and when the head began to distend the vulvovaginal ring, a large hematoma of the left labium majus gradually appeared. No increase in the size of the mass was noted and the general condition of the patient remained good. Ice compresses were applied to the hematoma after delivery. The mass gradually decreased in size with this treatment. No induration, tenderness or swelling of the vaginal walls was noted at the time of discharge from the hospital on the ninth postpartum day. In this case the expectant plan of treatment was carried out successfully. This type of management was chosen because the general condition of the patient was good, there was no evidence of bleeding, and the mass did not increase in size.

**CASE IV.** A twenty-eight-year old, white woman, nullipara, entered the Swedish Hospital on February 20, 1941. She was delivered spontaneously of a normal female infant weighing seven pounds and one ounce, after fourteen hours of labor, from the R. O. A. position. A right mediolateral episiotomy was repaired. Sixteen hours after delivery the patient began to complain of pain in the perineum, and vaginal bleeding was noted. She felt faint and

appeared pale. The blood pressure was 80/60 and the pulse 92 per minute. Examination disclosed a hematoma of the right labial and perineal areas, extending down to the right buttock. Following a transfusion of whole blood, the sutures were removed from the episiotomy wound, and large blood clots were evacuated from its bed and from the right ischiorectal fossa. A continuous ooze was noted from the upper angle and lateral wall of the episiotomy wound. This was controlled by packing the hematomatous cavity. The vagina was then packed tightly and a retention catheter was placed in the bladder. The patient was given a second transfusion and her general condition improved. The vaginal packing was removed in twenty-four hours and the ischiorectal packing in forty-eight hours. The patient was discharged from the hospital in good condition on the twentieth day postpartum. The bleeding, coagulation and prothrombin time were normal.

#### SUMMARY

1. A summary of the etiology, recognition and management of postpartum vulvar and paravaginal hematomas is presented.
2. Four cases of this postpartum complication are reported.
3. Three patients of this group were treated actively by opening of the hematoma, evacuation of the blood clots and packing. In addition, blood transfusions and supportive therapy were given. All patients made an uneventful recovery.
4. One patient progressed satisfactorily and fully recovered under expectant treatment.

#### CONCLUSIONS

1. The possibility of labial or paravaginal hematoma occurring as a postpartum complication should be borne in mind.
2. The self-limited case can be adequately treated expectantly and conservatively.
3. Those cases which show signs of failure to become self-limited should be treated actively in the manner advocated by Hamilton, namely, incision, evacuation

of blood clots, packing, and supportive therapy as indicated.

## REFERENCES

1. HAMILTON, H. G. Postpartum labial and paravaginal hematomas. *Am. J. Obst. & Gynec.*, 39: 642-648, 1940.
2. DAVIS, F. A. *Gynecology and Obstetrics*. Vol. 1, p. 1940. Hagerstown, Md., 1941. W. F. Prior & Co.
3. Ibid.<sup>2</sup>
4. Ibid.<sup>2</sup>
5. WILLIAMS, W. *Obstetrics*, 5th ed., p. 1026. New York, 1926. D. Appleton & Co.
6. DELEE, J. B. *Principles and Practice of Obstetrics*. 7th ed., p. 845. Philadelphia, W. B. Saunders & Co.
7. Ibid.<sup>6</sup>
8. SCHUMANN, F. *Textbook of Obstetrics*. p. 593. Philadelphia, W. B. Saunders & Co.
9. Ibid.<sup>2</sup>
10. EDGAR, W. *Practice of Obstetrics*, 6th ed., p. 487. Philadelphia, P. Blakiston & Sons.
11. MICHAELS, J. P. and HERRING, G. S. Postpartal hematomata. *New Orleans M. & S. J.*, 95: 37-39, 1942.
12. Ibid.<sup>10</sup>
13. Ibid.<sup>1</sup>



PARAVAGINAL hematoma and hemorrhage within the broad ligaments are quite easy to diagnose, as a rule. Retroperitoneal, being much slower, as a rule, than intraperitoneal hemorrhage, and inaccessibly situated, is probably the most difficult of all these conditions to diagnose.

# SUBASTRAGALOID DISLOCATION

## REPORT OF AN UNUSUAL SKI INJURY

MAJOR MERLE J. BROWN, M.C. AND CAPTAIN WALTER E. BROWN, JR., M.C.

Chief of Surgical Service, Station Hospital

Chief of Radiology Service, Station Hospital

CAMP HALE, COLORADO

**D**ISLOCATIONS about the ankle joint involving the astragalus are rare. Key and Conwell describe the force involved as being a severe torsion, but remark that this force usually accounts for fractures or fracture dislocations. Very few cases of subastragaloid dislocations, without fractures, have been reported.



FIG. 1. Complete dislocation of the os calcis on the talus with 90 degrees lateral rotation.

The typical description of this dislocation (Key and Conwell) is that the astragalus remains in the mortise of the ankle joint and the foot is displaced forward, backward, inward, or outward, depending on the force involved in the injury. The subastragaloid and astragaloscaphoid joints are displaced upon the astragalus. Clinically, this distortion of joints results in severe swelling and complete disability of the foot and ankle with the foot fixed in an abnormal position in relation to the leg.

Because of the twisting and distortion of tissues, circulatory changes may occur soon after the injury. This factor necessitates immediate reduction of the dislocation.

The following case report illustrates the dislocation at the subastragaloid joint as produced by a force of external rotation.

### CASE REPORT

The patient was admitted to the Station Hospital December 6, 1942, with the complaint of pain and swelling of the right ankle. Under authorized skiing he was coming down a hill at a moderate speed, but lost control and began to fall. A tree nearby caught the front end of the ski; and as the forward momental force carried the weight of his body past the tree, a torsion external rotating force was produced on the left ankle. Immediately after the fall the patient was unable to bear weight and noted that his left foot was displaced outward in comparison to the right foot. He was brought to the hospital immediately following the accident.

Physical examination on admission showed marked deformity of the left ankle with the foot projecting at a 90 degree angle lateralward in relation to the leg. There was marked deformity of the ankle joint with general diffuse swelling. There were some ecchymoses medial and lateral over the os calcis portion of the foot and below the ankle joint proper. There was slight motion in the ankle joint but this motion produced severe pain. No crepitus could be found. Palpation during examination indicated excruciating tenderness in the area of the involved joint.

X-ray studies showed a complete dislocation of the os calcis on the talus with 90 degrees lateral rotation of the foot, the scaphoid bone being separated anteriorly from the talus. There was no fracture apparent. Reproduction of the preoperative x-ray film is shown in Figure 1.

Immediately following the completion of the diagnosis, the patient was given morphine

sulfate gr.  $\frac{1}{2}$  and atropine gr.  $\frac{1}{150}$  hypodermically. Preparations were then made for reduction of the dislocation under anesthesia. Time was allowed for the narcotic to become

forward. This slight displacement was corrected by removal of the original cast and recasting the extremity with the foot in full dorsiflexion.



FIG. 2.



FIG. 3.

FIG. 2. Anteroposterior and lateral projections.

FIG. 3. Post-reduction showing anatomic relationships of the ankle joint.

effective, then the patient was given sodium pentothal .25 Gm. intravenously. With the patient completely relaxed, gentle manual traction and internal rotation was accomplished with sudden and nearly complete reduction of the dislocation. X-ray examination immediately after reduction showed nearly complete reduction except for a slight forward displacement of the astragalus with the foot in a semiflexed position.

The day following reduction, December 7th, with the extremity in a circular cast to the tibial tubercle, the x-ray checkup showed the foot in approximately 85 per cent dorsiflexion and the talus remained displaced slightly

The cast was worn two weeks and x-ray checkup December 21, 1942, showed a normal left ankle joint. (Figs. 2 and 3.) On this day the cast was removed and weight-bearing was allowed. In four days swelling was no longer present and good joint motion was present without pain or stiffness. The patient was discharged to full duty approximately four weeks after the injury.

#### SUMMARY

A case of subastragaloid dislocation of the left ankle occurring during authorized military skiing is reported.



# New Instruments

## MODIFIED OVERHEAD SUPPORT FOR POSTOPERATIVE USE

WALTER G. GOEHRING, M.D.  
Surgeon, Passavant Hospital

AND

W. ORR GOEHRING, M.D.  
Associate Surgeon, Passavant Hospital

PITTSBURGH, PENNSYLVANIA

THE use of an overhead support on the bed of postoperative patients is not new. For the most part, however, its

visit to the Massachusetts General Hospital where we saw the Balkan frame being employed on the surgical services for the

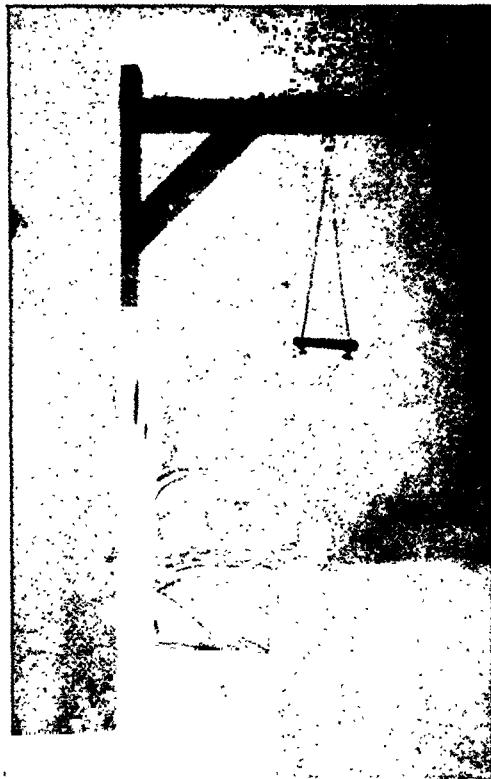


FIG. 1. Side view showing 26 inch cross bar of  $1\frac{3}{4}$  by 3 inch white pine inset into upright 6 feet 6 inches high. Site of 4 inch long three-eighths eye bolt, easily varied.



FIG. 2. Front view showing fixation of trapeze to prevent side slip.

use has been confined to traumatic and orthopedic cases. The standard textbooks on surgery and postoperative care, for example, make no mention of its use in abdominal surgery. We first became interested in its greater possibilities after a

older age group of patients and for hernia cases. So obvious are its advantages, and so pleased are we with the results obtained that it is difficult to understand its lack of wider acceptance. In this day of overtaxed hospital personnel, anything which lessens the amount of nursing care re-

quired—and the overhead support most assuredly does that—deserves thoughtful consideration. It is because of this, that a

hence, a large number can always be kept at hand. It is adaptable to all bed types; it is adjustable to suit the patient. It is



FIG. 3. Rear view showing 2 by 6 inch white pine upright fastened to bed by rope ties.

modified type of overhead bar which seems to us to offer several advantages, is being presented.

At first, we, too, used a Balkan frame. The insufficient number available never seemed to be where needed, and the job of transferring and setting them up required time and was not one for the nursing staff. Various adaptations were tried, each one having some drawback. Finally, with the assistance of Mr. Wenzel, the hospital carpenter, the overhead bar shown in the illustrations was evolved. It is inexpensive and easy to construct,

light in weight and can be readily transported and set up by a nurse. It has proved highly satisfactory to patients, doctors and nurses alike, and is now widely used in our hospital by all the surgeons as well as by some of the medical men. Whether or not such an apparatus is responsible for the lowered morbidity and mortality figures we are experiencing postoperatively is difficult to determine, because so many factors are involved. We do know, however, our patients now require less nursing attention and care. This alone would seem to justify its wider adoption today.



# SIMPLE APPARATUS FOR THE CARE OF AN ILEOSTOMY

JOHN H. GRINDLAY, M.D.\*

MILWAUKEE, WISCONSIN

THE avoidance of ulceration about an ileostomy which has been performed is always a matter of concern to the

diameter, is cut in the center of the nipple, and the other, about 3 mm. in diameter, is cut in the dome adjacent to the flanged

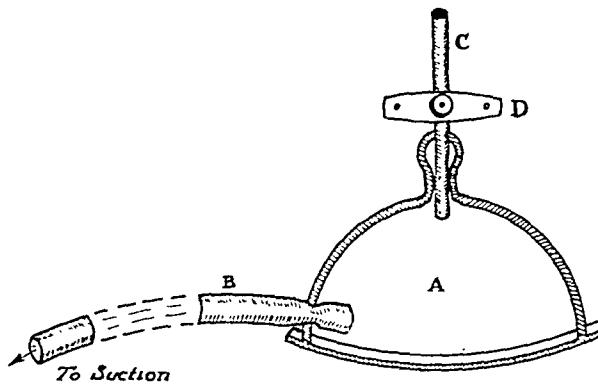


FIG. 1. Lateral diagrammatic view of ileostomy apparatus.  
A, Latex rubber nursing bottle cap. This is placed over the ileostomy, the flanged rim becoming imbedded in the vaseline gauze dressing surrounding the stoma. B, large soft rubber urethral catheter, from which the tip and a part of the flared end have been removed. The distal end of this catheter connects with the suction apparatus. C, piece of small soft rubber catheter. D, Hoffman clamp. Catheters B and C have been inserted through small holes in the lower portion of the dome of the nursing bottle cap, and in the tip of the nipple of the cap, respectively.

surgeon. The problem is not frequently encountered and yet, when it is encountered, much time is lost and damage done before a satisfactory method of caring for the irritating discharges is adopted. There are several well known methods of caring for the ileostomy stoma; all of these require a particular skill and watchful care to be satisfactory. The following apparatus has been used successfully by the author:

The main portion of the apparatus consists of the latex rubber cap of a wide-mouth, infant nursing bottle. Caps of this type are available commercially. The essential features of the cap are a nipple, a large dome and a flanged rim. The first step in the preparation of the cap is to cut two small holes. One, about 2 mm. in

rim. The latter hole is best placed by the point where the flange is broadened to form a tab. A large, soft-rubber, urethral catheter (about No. 26 Fr. in size) is then lubricated with soap and drawn out through the hole at the edge of the dome of the cap. Almost the entire catheter, tip first, is drawn through until the flaring end of the catheter protrudes only slightly beyond the concave inner surface of the dome of the nursing bottle cap. Before inserting the catheter it is well to cut off the less rigid distal one-half inch of the flared end. A second, small, soft-rubber, urethral catheter (about No. 12 Fr. size) is then drawn out through the hole in the nipple by the method just described. It is well to have removed the

\* Dr. Grindlay is now a Major in the Medical Corps of the United States Army.

flared end of this catheter and to allow it to protrude into the lumen of the nipple for a distance of about one inch. Finally, the tips of both catheters are cut off, leaving the larger catheter long and shortening the smaller catheter so that it protrudes only about two inches from the nipple.

This apparatus is applied to the ileostomy in the following fashion: The surface of the skin adjacent to the ileostomy is cleaned, dried and completely covered with several layers of vaseline gauze. The apparatus is placed over the ileostomy so that the flanged rim rests on the bed of vaseline gauze. The larger catheter is connected to a suction apparatus and the smaller catheter is held pinched off by a Hoffman clamp. When suction is started

the flanged rim of the cap becomes firmly imbedded in the vaseline gauze, forming an air tight seal about the ileostomy stoma. The suction serves not only to hold the apparatus in place but it removes liquid and gas as soon as they are discharged from the stoma.

Any type of apparatus giving continuous suction may be used. The commonly used three-bottle siphon system is entirely adequate. The Hoffman clamp may be opened slightly in order to modify a too powerful negative pressure, or it may be opened widely to flush out the apparatus with air or saline. It has been found that a daily dressing with renewal of the vaseline gauze is adequate. The apparatus may be discarded when the discharges take on the characteristics of ileostomy stools.



FIBRO-ADENOMATA of the cervix differ from those arising in the endometrium only in the fact that they are rough on the surface, are covered with the cervical type of mucosa, and do not usually exhibit the changes of the menstrual cycle.

The brief excerpts in this issue have been taken from "Essentials of Gynecology" by Willard R. Cooke (J. B. Lippincott Company).

# Bookshelf Browsing

## AMERICAN PIONEERS IN ABDOMINAL SURGERY

BERNARD J. FICARRA, M.D.

Resident Surgeon, Kings County Hospital

BROOKLYN, NEW YORK

THE rise of specialism and its rapid advancement is the most startling single feature of modern medicine. Surgery as a distinct specialty is representative of the various specialties. The changes wrought in abdominal surgery during the past fifty years are so amazing that to recount a surgeon's experience of that period would simulate an apocryphal tale.

Less than a century ago the most serious operations were performed without the aid of anesthesia and without the benefit of the most rudimentary aseptic precautions. Even in 1890 abdominal operations were infrequently performed. An appendectomy was a rare procedure and the surgical technic of the period was gruesome.

It is related how Dr. Alexander Mott, dressed in a Prince Albert coat, with white shirt cuffs showing, operated at Bellevue. He would put the scalpel in his mouth with several strands of waxed silk. The sponges used were ordinary reef sponges kept in the usual type wash basin. The water was changed only when it became too bloody. Instruments were kept in a mahogany box carrying case. When the operation was completed, the instruments were dried and replaced in the velvet-lined box for the next patient.<sup>25</sup>

From this primordial beginning has been formulated a highly technical and scientific specialty. Early American surgeons were concerned in applying the surgical knowledge in America which they had gained from Europe. Our surgeons of this century have advanced beyond their preceptors and now enjoy the leading world position in

surgical progress and practice. With the acquisition of this leadership, the debt of gratitude which the world owes to American surgery has increased beyond all estimation. Although many nations, older than America, have contributed many notable accomplishments, pioneers in American surgery evolved the basis for the modern advancement of this specialty. This advancement is displayed not only in regard to original research but in the introduction of newer methods of treatment, in the perfection of older operative procedures, and in tangible results. These achievements of American surgery cannot help but elicit universal admiration from the surgeons of the world. What our country has contributed to the creation of modern abdominal surgery is the worthy subject of this essay.

### COLONIAL SURGERY

When the colonies were about to be molded into a nation, the name of no American appeared upon the honor scroll of brilliant men who had made the surgery of the world famous. Occasionally, an outstanding surgeon is noted, but his fame is purely local. Others, such as Dr. Warren and Dr. Prescott, were imbued with the patriotic spirit, thereby forsaking their profession for the cause of liberty. It was through their efforts that the movements of the British troops were reported to the colonial army. In the colonial army itself Dr. Jones was the best known surgeon (from 1775 to 1781). Among the great things which medical officers of the American army have contributed to medicine,

attention is drawn to the first American book on surgery. This was written by Surgeon John Jones, U.S.A. (1729-1791) which was published in 1775. This book contains many pages on the treatment of war injuries and detailed descriptions of amputations. Jones was appointed the first occupant of the chair of surgery at Columbia University.<sup>15</sup> The first professor of surgery in colonial America was William Shippen (1736-1808). At one time he was Director General of the Continental Army. He was appointed professor of surgery at the University of Pennsylvania in 1766.<sup>15</sup>

The turbulent days of the period permitted no chronology of medical history. For this reason scattered individual surgical contributions are recorded as indicative of the progress in colonial America. The honor of leading the procession belongs to John Bard (1716-1799) of New York. In 1759, Bard performed what is called a "gastrotomy" for extra-uterine pregnancy. This procedure was subsequently repeated in 1791, and again in 1799, by William Baynham (1749-1814). Samuel (1742-1821), the son of John Bard, organized Columbia Medical School becoming its first dean. He was physician to George Washington when the seat of government was in New York. A name worthy of mention is Thomas Bond (1712-1784). He was apparently the first in the United States to perform a lithotomy. Bond and his son, Phineas Bond, rendered a distinguished service in 1776 by actively organizing the medical department of the colonial army. As an interesting notation it is recorded that Benjamin Franklin invented the flexible catheter.<sup>8</sup>

These patriotic men of medicine were our first practicing surgeons. Courageous in war and science, it was they and their successors who founded our schools of medicine and brought into being American surgery.

#### FOUNDERS OF AMERICAN SURGERY

The history of great deeds is basically the story of the men who have perfected

them. In the history of surgery two men stand forth as the fathers of American surgery: Philip Syng Physick and Ephraim McDowell.

Philip Syng Physick (1766-1837) studied at the University of Pennsylvania under Adam Kuhn and then went abroad to study under John Hunter. In 1792, he received his degree from Edinburgh. In 1794, he was elected surgeon to the Pennsylvania Hospital. Later he was made professor of surgery at the University of Pennsylvania. As a teacher he acquired the title, "Father of American Surgery." One of his most publicized operations was the lithotomy performed on Chief Justice Marshall, in 1831, when the judge was in his seventy-fifth year. Physick was one of the first surgeons to employ gastric lavage. He perfected an operation for the cure of "artificial pouches" (diverticuli) in the alimentary canal (1809). He devised a procedure of ligating artificial openings (fistulas) which had been made in the intestine due to pathological changes. Among his other achievements may be mentioned his description of rectal diverticuli and his operation for artificial anus (1826). As an innovation he introduced the use of kid and buckskin ligatures (1816) and invented the tonsillotome.<sup>22</sup>

The dawn of abdominal surgery starts with the historical scene in Danville, Kentucky, 1809. Dr. Ephraim McDowell (1771-1830), an unknown pioneer surgeon, trained in Edinburgh, was called to see Mrs. Jane Todd Crawford, sixty-five miles away in Greenville. The story of how she consented to submit to ovariotomy is too well known to recount. In the subsequent years, McDowell performed the operation twelve times, seven of which were successful. His valiant initiative was a great stimulus toward the development of American surgery. As the originator of this operation he made possible the development of the present field of abdominal surgery. McDowell's pioneer surgery will live in the memory of science as long as time endures.

Encouraged by the splendid results of McDowell, other American surgeons began to report their successes. Four years later a complete hysterectomy was performed by Joseph Glover of South Carolina (1813). Two surgeons, brothers, John Light Atlee (1799-1885) and Washington Lemuel Atlee (1808-1878) assisted in establishing ovariotomy after McDowell. They elaborated a procedure which enabled them to perform 465 operations in 1842 and 1843.<sup>11</sup> Other names prominently associated with ovariotomy are Nathan Smith, Dunlap, Peaslee, Kimball, Sims and Thomas. Against all these men the most caustic invectives were hurled. Yet their fearless efforts resulted in the acceptance of this procedure. To them must be given the gratitude of the world, since they brought a light into this dark region of surgery.<sup>6</sup>

Not many realize the profound influence McDowell's first ovariotomy had upon the entire field of abdominal surgery. An infant nation had startled the world in the fearful and formidable operation of extracting diseased ovaries. There was no precedent to warrant such surgical interference. Yet guided by a correct knowledge of pathology and possessed of trained operative skill, McDowell performed his part well. When the patient recovered, the drama was completed. Ovariotomy was given to the world and the name of the first American surgeon was immortalized on the honor roll of medical history.

#### THE WARREN FAMILY

The fortunes of war during the struggle for independence resulted in many casualties. For the treatment of the wounded an army hospital was established in Boston. The surgeon was Dr. John Warren (1753-1815). It was his desire to utilize the clinical material of the hospital for teaching purposes. In addition to clinical instruction, he held formal lectures in anatomy. These lectures were attended by Harvard students who were to undertake the study of medicine. Interest was drawn to this instruction by the large

quantity of students who visited his lecture hall. The Harvard authorities invited him to lecture at Cambridge as well as to assist them in the founding of a medical school (1780). Dr. John Warren was a younger brother of Dr. Joseph Warren who fell at Bunker Hill. He had served as an army surgeon throughout the war. During the postwar years he attained much eminence in Boston.<sup>3</sup>

John Collins Warren was born in Boston (1778). He was the eldest son of Dr. John Warren and the nephew of General Joseph Warren, who did so much for colonial liberty. Graduating from Harvard College (1797) he read medicine with his father, finally journeying to Paris and London for further study. He graduated from Edinburgh with a doctorate. When he returned to Boston, he began to practice with his father (1802). Four years later, he was made adjunct professor of anatomy and surgery and finally full professor when his father died (1815). He resigned from the chair of surgery at Harvard in 1847.

Among Dr. Warren's greatest accomplishments was the founding of the *New England Journal of Medicine & Surgery* with Dr. Jackson and Dr. Bigelow. He assisted in the formation of the Massachusetts General Hospital and served as its first surgeon from 1820 to 1853. The most famous event in his professional life was the operation he performed under ether on October 16, 1846. This operation demonstrated the value of ether in the advancement of modern surgical anesthesia.<sup>3</sup>

After the death of John C. Warren (1855) his son, Jonathan Mason Warren (1811-1867), continued the family tradition as one of the most renowned Bostonian surgeons. Following his graduation from Harvard, he sojourned in Europe. While in London he visited the clinics of Sir Astley Cooper; in Paris he witnessed the work of Dupuytren, Lisfranc and Larrey. Returning to Boston he began to practice (1835). In 1846, he became one of the visiting surgeons to the Massachusetts General

Hospital where he assisted his father in that memorable ether operation. While returning from a meeting of the American Medical Association in New York, the train on which he was a passenger was wrecked (1853). Although he was not actually injured, his health was seriously impaired thereafter until his death (1867).

Jonathan Warren had a son, John Collins Warren, who, like his father, graduated from Harvard (1886). He, in turn, became a professor of surgery and attending surgeon to Massachusetts General Hospital. As editor of the *Boston Medical Journal* he contributed much to surgical literature. At the time of his death (1927) he had served as president of the American Surgical Association.

The family heritage is carried on by his son, John C. Warren, who was an associate professor of surgery at the time of his father's demise. There are few, if any families, to contribute so much to the history of American surgery. No one could seek a more spotless record in the annals of medical history than that presented by the Warren family.<sup>23</sup>

#### PRE-ANESTHETIC SURGEONS

The years preceding the use of anesthesia is properly termed the rough years of surgery. Surgeons had to be stronger than the patient in order to restrain the subject and defend himself from the patient's outbursts. Too often the surgeon was not able to concentrate his attention upon the surgical task because of the cries and struggles of his patient.

A great surgical pioneer of this period was Valentine Mott (1785-1865) of New York. His many operations are too numerous to relate. Ligating of vessels was his most daring feat. In this dangerous pre-anesthetic and pre-antiseptic era he successfully ligated 138 aneurysms. On one occasion he ligated a common iliac artery through the abdomen (1828). When he was professor of surgery at Rutgers College, he wrote: ". . . we think it may henceforth be regarded as an axiom that it is the duty

of a surgeon to operate in every case which allows of a rational hope of success, either of improving the patient's condition or of preserving his life. . . . We do not believe it proper for every man who is nominally of the profession to assume such high responsibilities but that we regard those as surgeons, and those alone, who have, by conscientious devotion to the study of our science, and the daily multifarious duties, acquired that knowledge which renders the mind of the practitioner serene, his judgment sound and hands skillful; while it holds out to the patient rational hopes of amended health and prolonged life.\*

Mott was a bold operator, a pioneer teacher of clinical surgery, and one of the earliest professors of surgery in New York. When the Civil War was declared he was an old man. Nevertheless he assembled many valuable notes which he employed to write his excellent monograph on hemorrhage. This treatise was published by the U.S. Sanitary Commission.<sup>2</sup>

Another eminent surgeon was Willard Parker (1800-1885). He was famous for his original surgical technic which attracted many students to Columbia Medical School. Here he was professor of surgery (1839-1860). Among his proficient operations was cystotomy, a procedure which he perfected for the repair of the bladder following rupture or the removal of calculi.

During these formative years in American surgery, a laparotomy was performed by a southern surgeon, Dr. Wilson (1831). This was undertaken for the relief of an intussusception in a negro slave who had an intestinal obstruction for seventeen days. The abdomen was opened and the intussusception released with complete recovery of the patient.

Other interesting surgical undertakings were recorded. Dr. Joseph Glover, of South Carolina, removed part of the spleen, some omentum and ligated a branch of the splenic vessels (1801). A traumatic injury

\* Am. J. Med. Soc., vol. III, 1829.

to the spleen due to gunshot wound gave Dr. Alston, of Texas, the opportunity to perform a splenectomy (1863).<sup>8,22</sup>

Elective surgery was not a feature of the pre-anesthesia decades. Surgical intervention was an emergency, life-saving undertaking. Patients were coerced into submitting to surgery, either as a last resort or because their unconscious state rendered objection impossible.

#### AMERICA'S GREATEST SURGICAL CONTRIBUTIONS

There are two non-surgical subjects which have profoundly accelerated surgical progress: The first is the introduction of anesthesia, and the second is the elucidation of shock. Both these topics are truly American. No other nation can claim priority for the discovery of the former, and no one has contributed more to the understanding of the latter than American surgeons.

A great change has been brought about in the practice of abdominal surgery by the introduction of anesthesia. Patients will now consent to operations which formerly they would rather have died than endure. Thus many new operations which would have been impracticable are now feasible. In this way the range of operative surgery has been greatly extended. By means of anesthesia the patient is liberated from pain and in a great degree from the mental anxiety and disquietude which formerly preceded an operation. This is undoubtedly a contributing factor in diminishing the physical shock of an operation.<sup>1</sup>

The discovery of anesthesia produced a bitter discussion as to the real discoverer. Dr. Crawford W. Long (1815-1878), of Georgia, was the first man to use ether as an agent to relieve the pain of surgical operations. In 1847, he administered ether to his own wife at childbirth and continued to use it in his obstetrical practice. Long's classical operation occurred on March 30, 1842. On that day a man named James

Venables, while under the influence of ether, had a small cystic tumor removed from his neck. Long did not push himself into the arena as a claimant for the honor of the discovery of anesthesia until 1854. At that time he wrote to Senator Dawson of the U. S. Senate giving him an account of what he had done.<sup>23</sup>

To William T. Morton (1819-1868) is given the credit of demonstrating the practicability of ether anesthesia. Morton graduated from the Baltimore College of Dental Surgery, and entered into partnership with Dr. Horace Wells to practice dentistry in Boston. On September 30, 1846, he extracted a tooth while the patient was unconscious from ether. It was on this day that he spoke to Dr. C. T. Jackson on the subject.

Morton was anxious to receive the approbation of the medical profession on ether anesthesia. He called on Dr. Joseph C. Warren and explained his anxiety in the matter. So it came to pass that Dr. Warren, with Dr. Morton as anesthetist, removed a tumor from the left side of the face of Gilbert Abbott (October 16, 1846).

Among the many other names associated with anesthesia is that of Horace Wells (1815-1848). He was a dentist who observed a young man who had inhaled nitrous oxide bruise himself against furniture without complaining of pain. The next day he gave himself the gas and allowed a Dr. Riggs to pull one of his teeth. He felt no pain (1844). He at once began the manufacture and use of nitrous oxide. Wells attempted to gain priority rights as the discoverer of anesthesia. While the anesthesia controversy was raging he committed suicide in 1848.<sup>23</sup>

One blemish mars the beauty of the anesthesia discovery. The scar is the altercation for fame among the pioneer anesthetists. It is not of great importance to defend the true discoverer of anesthesia. Suffice it to be acclaimed as a true American discovery; no other nation can question this claim. The incalculable assistance given to abdominal surgery by this dis-

covery cannot be described adequately. This American discovery was the first revolutionary contribution recorded in surgical history. It is a disclosure touching the brim of metaphysics—a safe substance producing anesthesia and inducing sleep. All the influences emanating from the introduction of anesthesia is attributed to it. Thus the progress which abdominal surgery has made from year to year owes its origin to an American discovery.

America's greatest contribution has been surgical anesthesia. Nevertheless there is another contribution, less dramatic perhaps, but none the less highly commendable. The subject of shock has been elucidated largely through the efforts of Americans. No individual beams forth in the unfolding picture on the nature of and treatment of shock, as in the drama of anesthesia.

At the birth of this century the nature of shock was a nebulous enigma. Only the crudest ideas were postulated by surgeons of the world as to the mechanism of shock. All realized how serious and frequent a complication this was following severe injuries and major operations. The world of medicine was eager to listen to some voice in the wilderness which would raise the pall of ignorance. None was heard until George W. Crile (1864-1942) published the results of his investigations (1899). Although his conclusions were not correct, nevertheless his work stimulated others to exert their efforts to solve this perplexing problem.

More recent years produced notable facts which have assisted in clearing the mist surrounding the mechanism of shock. The modern American investigators, Blalock, Keith, Phemister, Moon, Scudder and others have added greatly to our knowledge of this subject. To those other Americans who have studied the problem of combatting shock by employing blood and blood substitutes is due a laurel wreath of unfading fame. Through the efforts of Americans the ever present complication of shock, hardly less important

than infection, is on the road to exile from the modern operating theatre.<sup>6</sup>

#### TRANSITION PERIOD

Between the pre-antiseptic, pre-anesthesia decades and the era of aseptic, analgesic surgery was a period of blending of one with the other. Most important of those surgeons who crossed this bridge of transition was Samuel David Gross (1806-1884). Often called the Nestor of American surgery, he was the foremost American surgeon of his time. Gross invented many new instruments, was a prolific writer, and introduced deep sutures in wounds of the abdominal wall. As a medical historian he wrote a history of American surgery down to the year 1876. In addition, his *System of Surgery* published in 1859 was widely distributed. Dr. Gross was a popular teacher of surgery first at Louisville (1840) then at the Jefferson Medical College (1856). He did more for the advancement of American Surgery than any individual of his day. He was panurgic in his ability. Not only was he an original investigator and proficient operator, but as a teacher and writer he was a notable exponent of his craft.<sup>4</sup>

The most outstanding of the New England Surgeons at this time was Henry Jacob Bigelow (1816-1889). As professor of surgery at Harvard, and surgeon to the Massachusetts General Hospital he achieved fame for the bloodless reduction of the hip joint. So great was his influence in Boston that his words were accepted as dogma. Much is due to Bigelow for his efforts to establish the administration of ether as a permanent part of operative technic. He is well known as a pioneer in genitourinary surgery.

D. Hayes Agnew (1818-1892) was born in Pennsylvania and graduated from that university in 1838. His early days in medicine were as a country doctor. When he moved to Philadelphia, he began to teach in the Philadelphia School of Anatomy (1848). In 1870, he was appointed professor of clinical surgery at the Uni-

versity of Pennsylvania. In the following year he succeeded H. H. Smith as professor of the principles and practice of surgery. He achieved national fame by his attendance of President Garfield during his last illness.

When Dr. Agnew became Professor Emeritus of Surgery, his successor was John Ashhurst, Jr. (1839-1900). He was one of the most learned surgeons of America and a great teacher. Ashhurst, who disdained the use of antiseptics, claimed operative results as regards infection as good as those of the more progressive Agnew. Often his results were unwittingly obtained by observing simple cleanliness.<sup>4</sup> No man ever used his vast experience and profound learning to better purpose in the instruction of those who were to come after him.<sup>11,23</sup>

Another bright star in the surgical heavens was William Williams Keen (1837-1932). As professor of surgery at Jefferson Medical College he was one of the first to perform many surgical procedures. He not only contributed novel innovations to general surgery but invented new technics for sterilizing catgut, and was a pioneer in neurological surgery. He was a noted author, achieving renown for his *System of Surgery*. He wrote an essay on the *Early History of Practical Anatomy* (1870).

James Marion Sims (1813-1883) was not primarily an abdominal surgeon but a gynecologist. Nevertheless his rules of surgery were so influential that general surgeons followed his dictum on penetrating wounds. He maintained that a wound of entrance should be enlarged for adequate exposure; all wounded intestines should be sutured and bleeding vessels ligated; the peritoneal cavity should be thoroughly cleansed of all foreign matter before closing the external wound; the surgeon should decide whether the wound required drainage.

All these former surgeons of the transition period assisted in completing the metamorphosis in American surgery. They were the link which united primitive to

modern American surgery. With the passing of these notable figures, America became a leading figure in the world of medical science. In the subsequent decades America is to assume the dominating leadership in the world of surgery.

#### AMERICAN PIONEERS IN ASEPSIS

When Lister visited the United States at the International Medical Congress held in connection with the Centennial Exposition at Philadelphia, ten years had passed since his doctrine of antisepsis was promulgated (1876). His teachings in America were accepted with indifference.<sup>19</sup>

The reasons for American lethargy in this important aspect of surgery were several: First, the treatment procedure was changed so often that surgeons could not adapt themselves to frequent alterations. Secondly, the procedures advanced were so complicated that the surgeon himself had to be responsible for its proper administration. Lastly, the hostility of so many British surgeons (Nunnally, Paget, Humphrey, Callender, Tait, etc.) to Listerism minimized its importance to Americans.<sup>27</sup>

In appraising the early history of aseptic surgery in America, scattered apostles of Listerism are seen in several large cities. New Orleans, Chicago, New York and Baltimore were the domiciles of ardent advocates of asepsis.

Hostility to asepsis and skepticism were present among the surgeons of New Orleans. The only exception was a German surgeon, Dr. Moritz Schuppert (1817-?), born and educated in Marburg. As professor of surgery in the Charity Hospital Medical School he championed the cause of antiseptic surgery. In a lecture published in the *New Orleans Medical and Surgical Journal*, Schuppert stated: "Reports that the antiseptic treatment of wounds recommended by Lister promised to cause a revolution in surgical practice, did not permit me to rest, and the Spring of 1875 found me already on the road to visit those places from which such stunning facts

were reported." At the conclusion of this extensive monograph, he summarized his own experiences based on his personal operations in New Orleans at Charity Hospital.

Despite the excellent exposition of the subject by Schuppert, Listerism made very slow progress in Louisiana and the United States. This was due in no small measure to the antagonism of many American surgeons. As learned and progressive a surgeon as Ashhurst was, he wrote in his textbook: "The alleged superiority of the antiseptic method has not yet been demonstrated." This was eleven years after Lord Lister had issued his first announcement of the antiseptic doctrine.<sup>19</sup>

The topic of antisepsis has been an evolution in which several American surgeons were important contributors. To Edmund Andrews (1824-1904) and to Christian Fenger (1840-1902) goes the honor of first using aseptic technic in Chicago. Of the two, Christian Fenger was the more influential.

In the spring of 1878 he began to give lectures and demonstrations in pathology. This was a science unknown to Chicago physicians. Fenger quickly accepted the importance of surgical asepsis and introduced Listerian methods in the Cook County Hospital. After several years as pathologist, he so impressed the surgeons with his surgical knowledge, that he was appointed to the surgical staff at Cook County Hospital. Finally, in 1889, he was elevated to the surgical professorship at Rush Medical College.<sup>14</sup> Fenger was the first American surgeon to prove by autopsy the importance of aseptic technic. Necropsies before the acceptance of the principles of asepsis and antisepsis in surgery often disclosed not the disease from which the patient suffered during life but the complications that had caused death.<sup>14</sup>

Arpad G. Gerster (1848-?) was born in Hungary and educated abroad. He came to America and settled in New York. As an accomplished surgeon he was an attending surgeon at the German and Mt.

Sinai Hospitals. He was the first man in New York to practice surgery exclusively. In 1888, he published "The Rules of Aseptic and Antiseptic Surgery." This essay enjoyed a wide circulation, even as it stimulated surgical asepsis and an appreciation of abdominal surgical diseases.<sup>8</sup>

The most startling American contribution to aseptic technic occurred in 1890. William S. Halsted introduced the use of sterile rubber gloves by surgeons and his assistants in the operating room. The employment of "the boiled hands" brought about a radical change in surgical technic. The beneficial results of this contribution cannot be overestimated.

The development of surgical asepsis is indicative of the universality of the medical art: it was introduced by an Englishman and was adopted and advanced by continental nations. An American surgeon by the utilization of rubber gloves not only gave greater security to the manipulations of surgery, but protected the surgeon's hands from the harshness and injurious effects of chemical antiseptics. This is an example of how American surgeons have transformed the picture of modern surgery so that it no longer possesses its former appearance.

#### PERIOD OF REORGANIZATION

The postwar years of 1865 to 1898 in the United States were termed the reorganization period. For it was during these years that America turned to the reunion of the states, healed its wounds and accepted the new changes produced by the industrial revolution.

The effects of reorganization found its way into medicine. Prior to this period there was no central collection of medical literature and no method available for ascertaining what scientific material had been published. The Library of the Surgeon General's Office was a small collection of books which were inadequate. To John Shaw Billings (1838-1913) was given the task of reorganizing the medical literature of America.

As an army surgeon Billings has been termed one of its foremost medical officers (Hume). During the Civil War he rendered distinguished service at Chancellorsville and at Gettysburg, where he operated for three days without rest. He was the first American surgeon to resect successfully the ankle joint (1862). His history of American surgery is the best in the English language.

After the Civil War, Surgeon General Hammond gave Billings the assignment of directing the Library of the Surgeon General's Office. Billings had the foresight to recognize the need of a large library for the advancement of American surgery and medicine. Since his day this library, now known as the Army Medical Library, has become the largest in the world. Although this is not a true contribution to abdominal surgery, as many others already mentioned, nevertheless, the realm of books is an essential part of the surgeon's armamentarium. For to paraphrase Osler, the surgeon who does not read books is like the captain who goes to sea without a knowledge of navigation.

Billings realized that a mass of books with no catalogue would be like an auto without a steering apparatus. Thus he devised the *Index Catalogue*, the largest compendium of bibliography ever developed (1880). He also founded the *Index Medicus*, now called the *Quarterly Cumulative Index Medicus*, which supplements the great catalogue.<sup>11</sup>

As a bibliographer, Billings achieved world fame and honorary degrees from European universities. At the time of his death he was the best known American surgeon to European scientists.<sup>12</sup>

#### THE AMERICAN SURGICAL DISEASE

A surgical disease which is truly American from the point of view of frequency of occurrence in Americans, and the elucidation of its pathology and cure, is appendicitis. Before the American surgeons solved the riddle of appendicitis, the abdomen

was forbidden territory, and the operative treatment awaited its destined birth.

American surgery again enrolled itself upon the honor roll of everlasting fame by the exposition of the vermiciform appendix. The first step in the recognition of appendicitis was taken by George Lewis, of New York, (1856). Then followed the operation of Willard Parker (1860-1884) for perityphlitis abscess, which was simply an evacuation of the abscess (1867). Subsequently the removal of the appendix was accomplished by R. J. Hall, of New York, and Thomas G. Morton, of Philadelphia.

For the complete understanding of this lesion, all honor goes to Reginald Heber Fitz (1843-1913), of Boston. The indications for surgical treatment were definitely expounded in 1889 by Charles McBurney (1845-1913), of New York.

The story of appendicitis unfolds during the last half century. "First the disease had to be recognized and that takes us back to the Massachusetts General Hospital. Here young Fitz, recently returned from study under Virchow, was made Keeper of the Pathological Cabinet at the hospital. For some reason he became interested in what was commonly called typhlitis and perityphlitis. Soon he convinced himself that the appendix was the cause of this condition and that it was an unnecessary organ of the human body. Finally, when the Association of American Physicians was to hold its first meeting in June, 1886, he was scheduled to read his paper. This was entitled, "Perforating Inflammation of the Vermiform Appendix; with Special Reference to its Early Diagnosis and Treatment."<sup>9,10</sup>

At this meeting Fitz showed by comparison of many cases that perityphlitis and perforating appendicitis were the same pathological condition. In addition he outlined the main symptoms and used the name appendicitis for the first time.

While Fitz was telling the surgeons what they ought to do, European surgeons continued to treat the disease conservatively.

In America his advice was accepted, and the world began to hear of McBurney, Murphy, Senn, Sands, Fowler and Ochsner.

As previously mentioned Dr. Hall successfully removed an inflamed appendix. However, this operation was undertaken for what was thought to be an incarcerated inguinal hernia. When the hernial sac was opened, peritonitis due to a gangrenous appendix was found. In 1887, Thomas George Morton (1835-1903) diagnosed appendicular disease, operated, opened an abscess and removed the appendix with a successful result. This was the first successful appendectomy in which the operation was primarily undertaken for a diseased appendix.<sup>7</sup>

However, the great advancement in the early diagnosis and operative interference in appendicitis was due to the efforts of Sands and McBurney. Henry B. Sands (1830-1888) was the assistant of Willard Parker from 1867 to 1870; from him he learned how to open a perityphilitic abscess. Sands is entitled to remembrance because he taught surgeons how to recognize the early signs of perforated appendicitis and advocated early operation.<sup>7</sup>

To the work of Sands was added the efforts of Charles McBurney (1845-1913). His paper published in 1889 established by clinical experience the utter necessity for early operation in appendicitis.<sup>7</sup> He insisted that there was a specific area especially tender in cases of appendicitis. What is now known as McBurney's point was described thus: ". . . the seat of greatest pain determined by the pressure of one finger, has been very exactly between an inch and a half and two inches from the anterior spinous process of the ilium on a straight line drawn from that process to the umbilicus."<sup>20</sup> From that day (November 13, 1889) the early operation for appendicitis as taught by such surgeons as Murphy and Senn became customary in America.

Other important therapeutic measures were instituted by Americans. Alonzo Clark (1807-1877), of New York, intro-

duced the use of opium in peritonitis (1885). Another New Yorker, George Ryerson Fowler (1848-1906), advocated the sitting up position for cases of peritonitis. Thus inflammatory exudates would flow into the pelvis where absorption is not as rapid and drainage could be accomplished more satisfactorily.<sup>7</sup>

A new era was born in the field of abdominal surgery. Operations for the cure of appendicitis are performed daily. To this new surgery, American ingenuity was the major asset. Our nation achieved a brilliant triumph in this phase of abdominal surgery. To American surgeons perennial tribute must be given for initiating appendectomy and for perfecting its technic.

#### PATHFINDERS IN BILIARY AND GASTROINTESTINAL SURGERY

Less notable than the story of appendicitis but equally as important is the history of American surgery of the biliary and gastrointestinal tracts. Early surgery of these vital structures began with the repair of intestinal wounds. Later resection of the intestine, followed by anastomosis was perfected.

Intestinal wounds stimulated the interest of American surgeons as early as 1805. This subject was the inaugural treatise of Dr. Thomas Smith at the University of Pennsylvania. Samuel Gross, in 1843, experimented on dogs as to the nature and treatment of these wounds. Later he applied these results to actual practice. J. Marion Sims corroborated the method of Gross. This involved the excision of a section of the intestine with suturing of the divided ends. Gross never performed this procedure. It was in 1863 that Dr. Kinloch, of South Carolina, accomplished this result. However, it remained for Dr. N. T. Bull to make the practice safe. The efforts of Nicholas Senn and Abbe in intestinal anastomosis deserves distinction.

Other efforts were made in gastrointestinal surgery, however, most of these are

scattered reports. For example, in 1834, Luzenberg opened a strangulated hernia and excised the gangrenous bowel. The patient recovered.<sup>22</sup> *The Boston Journal of Medicine* of June 23, 1845, contains an article by a Dr. Manlore. This account reports a laparotomy for obstruction. An involuntary ileostomy was performed because the bowel was adherent to the abdominal wall. The author advocated this procedure in all cases of volvulus and intussusception.<sup>5</sup>

This same journal of July 23, 1868, contains a report by Dr. R. Wilder on "strangulation of the large intestine by a band." In this case he opened the abdomen, released the band with immediate relief. Five years later, Cheever reported a similar case with complete recovery of the patient.<sup>5</sup>

On September 23, 1885, an unfortunate man swallowed a denture with four teeth. It lodged in the esophagus. When he entered the hospital three days later, it was behind the sternum. The patient could not eat and lost much weight. A young surgeon, Maurice Richardson, opened the abdomen and stomach. He reached through the cardia up into the esophagus. With difficulty he liberated and delivered the denture. This procedure was the first of its kind to be reported.<sup>5</sup>

During these years sporadic successes with laparotomy, for various causes, found their way into the literature. The first and only successful laparotomy for the relief of perforation of the intestine due to typhoid fever is attributed to Dr. W. Van Hook, of Chicago. Laparotomy for the relief of purulent peritonitis was performed by Mears, of Philadelphia. This procedure was among the first in which the peritoneal cavity was opened for the purpose of draining the cavity. In association with this topic other names are prominent. Commendation must be given to Hartley, Curtis, Stimson, Morton and Vanderveer.<sup>5</sup>

The question of suture material fascinated American surgeons. Henry O. Marcy, of Otis, Massachusetts, introduced anti-

septic ligatures in the radical cure of hernia, using kangaroo tendon (1878). Fourteen years later, Robert Abbe (1851-?) introduced catgut rings in intestinal surgery. One of the most ingenious and useful suture in intestinal surgery is the Connell suture. This was devised by Gregory F. Connell (1875- ) now of Oshkosh, Wisconsin.<sup>7,8</sup>

Surgery of the stomach was advanced at the hands of Americans. Christian Fenger unfolded new facts on cancer of the stomach. The first man to take a radiogram of the stomach and confirm his findings surgically was John Conrad Hemmeter (1896). In addition he was a pioneer in duodenal intubation.<sup>5</sup>

On May 5, 1898, Dr. Charles B. Brigham reported a successful gastrectomy in the *Boston Medical Journal*.<sup>5</sup> He removed the entire stomach for cancer. An anastomosis was then made between the esophagus and the duodenum by means of a Murphy button. Two other names are prominently attached to the technic of gastrectomy both for cancer and ulcer. These men, both New Yorkers, are Albert Ashton Berg (1872- ) and the late beloved George David Stewart (1862-1933).

Preoperative care of the gastrointestinal tract was emphasized for the first time by an American (1900). It was through Harvey Cushing that surgeons realized the possibility of rendering the stomach and intestines sterile as a preparatory measure to operations.<sup>21</sup>

Abdominal surgery of infancy and childhood has been promoted by American surgeons. Among these men are: C. L. Scudder, E. J. Donovan, William Ladd and Robert Gross. Through these surgeons and others pediatric surgery has become a specialty within the specialty of abdominal surgery.

One of the aspects to the explanation for the enviable surgical position America has reached is her contribution to gastrointestinal surgery. In this phase of abdominal surgery, America displayed the inherent characteristic of a young nation; first, to

equal, then to excel the accomplishments of older nations.

This characteristic was further demonstrated in biliary surgery. In colonial days, John C. Warren excised biliary calculi by incision into the umbilical vein.<sup>5,23</sup> At the University of Indiana, Dr. John S. Bobbs was dean of medicine. He is the founder of cholecystotomy. On June 16, 1867, he opened a patient's gallbladder and extracted fifty calculi.<sup>26</sup> The next year witnessed a similar performance by J. Marion Sims. In 1879, Robert Lawson Tait (1845-1899), of Alabama, perfected cholecystotomy.<sup>11</sup>

Dr. Fenger became interested in diseases of the biliary system. This was due to Phineas Conner, of Cincinnati, who incised adherent suppurating gallbladders and removed gallstones. Thus it was that Fenger explained the ball-valve action of biliary calculi and their relationship to the production of jaundice.

The last decades of the nineteenth century produced additional data on the biliary system. W. B. Davis, of Alabama, did excellent work on the anatomy and surgery of the biliary ducts (1890). More difficult surgery was now attempted by American surgeons. On March 23, 1893, G. W. Jones reported making an anastomosis between the gallbladder and intestine for stricture of the common duct.<sup>5</sup> Five years later Halsted excised the ampulla of Vater and the papilla of the common duct because of cancer. A successful implantation of the common duct into the duodenum for the relief of stricture was reported, in 1908, by Horace W. Packard.<sup>6</sup>

Bile duct surgery continues to receive the greatest attention from American surgeons. Such interest has given birth to the use of vitallium tubes in biliary surgery. The pioneer in vitallium surgery of these structures is Herman E. Pearse, of Rochester, New York. Other surgeons to follow his leadership were: Howard M. Clute, of Boston, Ben Seaman, Russell Fowler and John Raycroft all of New York.

The remarkable work in biliary surgery typifies the courage of American surgeons. Their ability to undertake a new project with the utmost vigor and enthusiasm is here manifested. Self-reliance such as this has developed the art of surgery in America and has obtained for our nation the admiration of the civilized world.

#### THE PEERLESS SURGEONS

"Progress always rests upon a small number of men of genius. Thus we have in the science of surgery in every epoch and every country, a certain number of renowned men who are the causes and pillars of this achievement." (Wm. J. Mayo.) Progress in American surgery was accelerated by several men of genius. Although many generations are represented, only the most famous characters will be recalled to mind in this surgical saga of our own native land.

Among the pioneer surgeons of the Middle West was Nicholas Senn (1844-1909). Born in Switzerland, he came to America (1852) and settled in Chicago. As an early exponent of scientific and experimental surgery, he concerned himself with abdominal surgery. He devised a method of detecting intestinal perforation with hydrogen gas (1888). The merits of Senn were in stressing surgical technic and in experimental abdominal surgery. He was among the first experimenters in gastroenterostomy and bowel anastomosis. For intestinal anastomosis he used decalcified bone plates. Senn was the founder of the Association of Military Surgeons of the United States (1891). From 1905 to 1908 he was editor of *Surgery, Gynecology & Obstetrics*. At one time he was professor of surgery at Rush Medical School.

The work of Senn led naturally to the accomplishments of John Benjamin Murphy (1857-1916). One of America's own world acclaimed surgeons, Murphy is remembered especially for the "button" which bears his name. The Murphy button is a great aid in intestinal anastomosis. His fame in America is associated with the

founding of the American College of Surgeons.<sup>14</sup>

A more recent leader of Midwest surgery was Albert J. Ochsner (1858-1925). For five years he was Senn's chief-of-staff, and began in this clinic his distinguished work known as Ochsnerization. This is the treatment of appendicitis when operation is not advisable or available.

At the turn of the century two master surgeons enjoyed positions of eminence. These men were Deaver, of Philadelphia, and Halsted, of Baltimore. John Blair Deaver (1855-1931) was one of the most skillful operators of this period. He was an exponent of what he called "living pathology." The egregious character of his work is illustrated in his writings on: *Appendicitis* (1896), *Prostatic Hypertrophy* (1905), *The Breast* (1917), and a *Surgical Anatomy* (1901), in three volumes.<sup>4</sup>

An expert in the art of healing was William Stewart Halsted (1852-1922). As first professor of surgery at Johns Hopkins, he was a quiet but effective force in molding American surgery into a composite science. In addition to his introduction of sterile rubber gloves, he was a pioneer in the use of silk ligatures and cocaine infiltration anesthesia. He devised numerous operative procedures, such as those for radical mastectomy (1889) and herniorrhaphy. If any one man is to be given credit for initiating specialism in surgery, it is Halsted. He trained men who eventually became masters in different branches of surgery. During an all star operation, Halsted would operate with Cushing, Finney, Bloodgood, Young and Baetjer as assistants. Each of these assistants achieved deserving fame, some of whom pioneered in other branches of surgery. To these surgeons he taught the delicate art of the perfect healing of wounds, which was masterly demonstrated at his clinics.<sup>11</sup>

Halsted showed the necessity for the gentle handling of tissues as a corollary to the prevention of wound infections for the protection of patients against surgical shock. To him all honor is due for the

abolition of the rough and ready surgery which was prevalent before his day. Americans are justly proud of Halsted; he not only developed the science of surgery but cultivated its art as well.

The late George Washington Crile (1864-1942), of Cleveland, was known for many ingenious contributions to surgery. His experimental and clinical investigations of surgical shock and the reduction of operative shock by his procedure of "anoci-association" brought him to the attention of the medical profession. He achieved national fame for his technical ability of denervating the adrenal gland as well as for thyroidectomy.

All the world has heard of the Mayo Brothers. Their exceptional dexterity as surgeons, teachers and contributors to medicine made their names universally familiar. Founders of the world famous Mayo Clinic in Rochester, Minnesota, William James Mayo (1861-1939) and Charles Horace Mayo (1865-1939) were the authors of many accepted improvements in visceral surgery. By the establishment of their clinic they have opened the way for future discoveries in surgery. Many surgeons have been trained at the Mayo Clinic, and by their work have reflected honor and glory on the memory of Charles and William Mayo.<sup>3</sup> Among these master abdominal craftsmen mention is made of: E. Starr Judd (1878-1935), Donald C. Balfour, Waltman Walters and Fred Rankin. Today the Mayo Clinic is the post-graduate medical school of the University of Minnesota. At this university Owen H. Wangensteen is professor of surgery. He is noted for his remarkable work on intestinal obstructions. His book on that subject has been accepted as a classic and is destined to be one of the most valuable books in American medical literature.

The influence of the Mayo Clinic has been manifested in a different manner. Other clinics formed according to the Mayo pattern have been established in America. The most noted of these small

institutions is the Lahey Clinic, in Boston, founded by the distinguished surgeon, Frank Lahey. Here under the guidance of Lahey and Richard B. Cattell, young surgeons, through a system of fellowships, are trained in the flawless technic of graceful surgeons.

The accomplishments of these peerless surgeons must be evaluated according to the standards of the period in which they lived. They were influential during a definite period of American surgical growth and development. There will never again be men of their caliber. This is not because similar personalities may not be born, but because the era in which they lived will never again be duplicated in America.<sup>14</sup>

#### CONCLUSIONS

Following the adoption of asepsis and anesthesia as definite supplements to surgical technic, America was contented to follow the established principles inherited from the old world. Later generations progressed beyond European influence to become pathfinders in abdominal surgery. America is now the seat of learning to which surgeons of the world may come for knowledge. This century finds the American surgeon the leading figure in the realm of surgical practice, progress and prestige.

This exalted position has been attained for many reasons. Among these are the generous allowances made by universities and private individuals for the study of experimental and clinical surgery. In addition, America has been liberal in remunerating deserving surgeons for their ability.<sup>4</sup> Another reason has been the impartiality with which American surgeons gleaned the harvest from European discoveries. America eagerly seized the surgical contributions of England, France and Germany. Thus America appropriated to her own use whatever principles, theories, discoveries, inventions or knowledge Europe had to offer. With this adaptability for assimilating proffered knowledge, American surgeons, adding their own ob-

servations, contributed generously to the resources of surgery.<sup>15</sup>

Not only have American surgeons aimed to reach the acme of perfection, but they have examined themselves in order to maintain that supremacy. "This is reflected in the facilities for long term specialized education of the young surgeon. The high standards set for certification by the American Board of Surgery have been a very stimulating influence in maintaining the high level of surgical practice. The influence of the American College of Surgeons has assisted in improving surgical practice throughout the nation due to the increased standards for admission to fellowship."<sup>16</sup>

With the advent of a proper pathological basis for understanding disease, the American surgeon quickly accepted the need for training in pathology. This was a radical departure since hitherto surgeons relied primarily on anatomy as a basis for surgical proficiency. In the present century American surgeons have advanced further. They have added normal and pathological physiology to their knowledge as a requisite for surgical excellency.<sup>4</sup>

America has set high qualifications for the perfect surgeon: "He must be a physician possessed of the high ideals of a Hippocrates, the anatomical knowledge of a Vesalius, the alertness and fearlessness of a Paré, the intuitions and curiosity of a Hunter, the imagination of a Pasteur, and the industry and honesty of a Lister. To these must be added the good judgement which marks the difference between technical efficiency and true ability."<sup>12</sup> The essential ingredients, however, in the make-up of the surgeon are the mental, the moral and the mechanical. "The first has to do with knowledge, the second with judgement, and the third with skill. In such order they provide the why, the whether, and the how of every surgical question. The American surgeon recognizes this trinity of attributes and happy indeed is he—and rare in the extreme—who may possess them all in equal degree."<sup>24</sup>

These troubled days of war, commercialism, and social complexes welcome the ideals and aspirations of the medical scientist. "The commercial world exalts those who accumulate wealth; the politician defies the narrow-minded nationalist; and the unthinking citizen finds his hero in the theater. Surgery engrossed in scientific investigation and its application to the relief of human suffering, reserves its insignia of greatness for those who find their satisfaction in service and in the search for the elusive secrets which benefit mankind. The American surgeon, in common with all scientists, loves to wrest from nature its secrets for the pure joy of increasing knowledge. He may be oblivious of its immediate application, but he is confident of its ultimate value in alleviating human suffering."<sup>16</sup>

The turbulent era through which we are passing threatens to stifle surgical progress. "All other continents have forgotten the advancement of surgical science because of the war. The post-war years will be more occupied with reconstruction, than surgical prestige. Therefore, the preservation of present surgical standards and the energy for progress must arise from America."<sup>13</sup> Thus when a future historian of surgical history evaluates America, he can write that American surgeons have not only been illustrious pioneers in their specialty, but have also preserved, protected, and advanced it during the most critical period of its existence.

#### REFERENCES

1. ASHHURST, JOHN, JR. *Principles and Practice of Surgery*. Philadelphia, 1878. Henry C. Lea.
2. BEHNEMAN, HAROLD. The lure of medical history. *California & West. Med.*, 28: 668-672, 802, 1928.
3. BILLINGS, JOHN SHAW. *The History and Literature*

- of Surgery. In Dennis' *System of Surgery*. Philadelphia, 1895. Henry C. Lea.
4. CASTIGLIONI, ARTURO. *A History of Medicine*. New York, 1941. A. Knopf.
  5. CHEEVER, DAVID. A century of surgery. *New England J. Med.*, 198: 13, 1928.
  6. CHIPMAN, W. W. The surgery of America. *Surg., Gynec. & Obst.*, 43: 264, 1926.
  7. COPE, ZACHARY. *Pioneers in Acute Abdominal Surgery*. London, 1939. Oxford University Press.
  8. DENNIS, FREDERIC S. The achievements of American surgery. *Med. Rec.*, 42: 637-648, 1892.
  9. FITZ, REGINALD H. Perforating inflammation of the vermiform appendix. *Am. J. Med. Sc.*, 96: 321-45, 1886.
  10. FITZ, REGINALD H. The story of appendicitis. *J. South Carolina Med. Ass.*, 39: 1, 1943.
  11. GARRISON, FIELDING H. *An Introduction to the History of Medicine*. Philadelphia, 1929. Saunders.
  12. GATEWOOD, GATEWOOD. The making of a surgeon. *Am. J. Surg.*, 38: 397, 1937.
  13. GRAHAM, EVARTS. American surgery in a changing world. *Surg., Gynec. & Obst.*, 74: 273-80, 1942.
  14. HEKTOEN, LUDVIG. Early Pathology in Chicago and Christian Fenger. First Fenger Lecture of the Chicago Pathological Society, March, 1937.
  15. HUME, EDGAR E. Surgeon John Jones, U.S.A. *Bull. Hist. Med.*, 13: 10-32, 1943.
  16. KANAVEL, ALLEN B. Intangibles in surgery. *Surg., Gynec. & Obst.*, 56: 394, 1933.
  17. KELLY, HOWARD A. *American Medical Biographies*. Baltimore, 1920. Remington Co.
  18. MASON, MICHAEL. Significance of the American College of Surgeons. *Am. J. Surg.*, 51: 267, 1941.
  19. MATAS, RUDOLPH. Surgical operations fifty years ago. *Am. J. Surg.*, 51: 40, 1941.
  20. McBURNEY, CHARLES. Experience with early operative interference in cases of disease of the vermiform appendix. *New York State J. Med.*, 50: 676-84, 1889.
  21. MOYNIHAN, BERKELEY SIR. *Abdominal Operations*. Philadelphia, 1928. Saunders.
  22. NICHOLSON, C. M. Evolution of American surgery. *J. Missouri Med. Ass.*, 9: 10-14, 1912-1913.
  23. PACKARD, FRANCIS R. *History of Medicine in the United States*. New York, 1931. Paul B. Hoeber.
  24. ROYSTER, H. A. Surgical vision. *J. A. M. A.*, 99: 93-95, 1932.
  25. STEWART, GEORGE D. Unpublished Lectures Given at Bellevue Medical School.
  26. WALTERS, W. and SNELL, A. *Diseases of the Gall-bladder and Bile Ducts*. With an Introduction by Dr. William J. Mayo. Philadelphia, 1940. Saunders.
  27. WEIR, ROBERT. Quoted by Matas. Article in *New York Med. J.*, Dec., 1877 and Jan., 1878.

---

---

## Selected Book Reviews

---

AFTER all has been said and done one looks to the book review pages hoping to get some idea if certain books are worth owning, or if they contain the information one seeks. The reader wants to know if a book under discussion is "just a book," a run of the mill affair, or a book that has been written "from the ground up," whether it is a book of merit, a book that one can refer to with confidence, knowing it is scientifically sound.

In the past year medical book publishers have done very well. It has been rumored they have been having a field day. If sales have been brisk, it is because the publishers have given, for the most part, quality. The many recent new books and new editions have been good books, books that have and will fill many and various needs.

We cannot go into detail about many of these works because of space limitations due to paper shortage. As has been said before, we print only two columns (sometimes but one) and paper does not stretch. Therefore, we will recite bare facts and omit the details concerning a few volumes on our desk.

For the surgeon and the general practitioner (for it is the general practitioner who sees the patient first) we highly recommend "Diseases of the Breast" by Charles F. Geschickter,<sup>1</sup> with a special section on treatment written in collaboration with Dr. Murray M. Copeland. The authors are men of experience. This work of 829 pages and 593 illustrations plus an ample index covers diagnosis, pathology and treatment of breast conditions. References are at the chapter endings. The work is divided into seven parts and is well written; the illustrations are exceptionally fine. Would that all physicians who see patients with breast conditions were familiar with this volume.

"The Principles and Practice of Obstetrics" (8th Edition) by Joseph DeLee (what physician does not know this book?) has now

<sup>1</sup> Diseases of the Breast. By Charles F. Geschickter. Philadelphia, 1943. J. B. Lippincott. Price \$10.00.

been brought out in a new edition by Dr. J. P. Greenhill.<sup>2</sup> Dr. Greenhill has rearranged the material in the first third of the book; he has substituted English terms for Latin ones in the designation of presentation and position, and has added new chapters or sections dealing with obstetric and gynecologic endocrinology. The use of vitamin K in obstetrics, erythroblastosis fetalis, vitamins and minerals, roentgenography in obstetrics, the sulfonamide drugs in obstetrics, and the Waters extraperitoneal cesarean section are thoroughly done. Several chapters have been rewritten. Dr. Greenhill has done an excellent job and has made a book, that was a standard for several decades, a much better book.

The Williams & Wilkins Company, of Baltimore, have published, under the title "Pain," the Proceedings of the Association for Research in Nervous and Mental Disease.<sup>3</sup> This association has brought out research publications annually since 1920. "Pain" is a book of 468 pages with 116 illustrations and nineteen tables. The editorial board responsible for the finished work comprised Harold G. Wolf, Chairman, Herbert S. Gasser and Joseph C. Hinsey, and about thirty-seven scientists contributed to this volume. A bibliography is at the conclusion of each chapter and there is a good index. Those interested in this title will find the reading of this work profitable and stimulating.

"The Modern Management of Colitis" by J. Arnold Bargen,<sup>4</sup> Chief of the Section on Intestinal Diseases, Mayo Clinic, is not only timely but is a book that could well be studied by a majority of physicians. It deals with nature and causative factors of colitis, characteristic lesions, symptoms and clues to inception; we are given precise diagnostic criteria and treatment and the purpose of the various modes of treatment. There are case reports and consideration of complications and sequelae. This monograph of 322 pages and 148 illustrations, with references and index for the reader's convenience, is an outstanding and worth while work.

We have before us the fourth Edition of Max Thorek's "Surgical

<sup>2</sup> Principles and Practice of Obstetrics. 8th ed. By Joseph B. DeLee and J. P. Greenhill. Philadelphia, 1943. W. B. Saunders. Price \$10.00.

<sup>3</sup> Pain. Proceedings of the Association for Research in Nervous and Mental Disease. Vol. XXIII. Baltimore, 1943. Williams & Wilkins. Price \$7.50.

<sup>4</sup> The Modern Management of Colitis. By J. Arnold Bargen. Springfield, Ill., 1943. Charles C. Thomas. Price \$7.00.

Errors and Safeguards."<sup>5</sup> There is a foreword by Sir Hugh Devine and a chapter on Legal Responsibility in Surgical practice by Dr. Hubert Winston Smith. The book was first published in 1932. When a book of this size and scope (1085 pages and 795 illustrations, many of them colored) comes out in a fourth edition in ten years, that book must be a good and necessary tome. Naturally, it is well and clearly written. The illustrations are of a high order and the volume abounds in references and is amply indexed. That Thorek's work is now offered in a fourth edition is enough recommendation.

By the way, have you read Dr. Thorek's autobiography,<sup>6</sup> "A Surgeon's World"? We picked it up thinking it would prove to be just another prominent medico resorting to the pen in order to tickle his ego and vanity, and instead found ourselves fascinated. Pick it up a half hour or so before bedtime and become acquainted with the boy at school in Budapest, the student who played snare drums to get his medical degree, the physician who mended Mother Mellaney's sons, the surgeon who planned and built a hospital. This autobiography makes for lively reading, for not only do you become acquainted with the author but you will meet homey little sketches of others' lives.

We have just enough space left to refer briefly to three books, mainly of interest to gynecologists, but others might well enjoy them, too.

The first one is called "The Genealogy of Gynaecology." It is by James V. Ricci<sup>7</sup> and is a history of the development of gynecology throughout the ages—2000 B.C. to 1800 A.D. There are excerpts from many authors who have contributed to the various phases of the subject. It is a storehouse of facts, dates, names and places dealing with the development of the theories and therapies of female diseases throughout the ages. Here and there through the text are many phrases of elegance and beauty chosen from the masters in the art of expression which add charm and meaning to the gynecological items culled from the past. The material while always instructive is often amusing. This work of 578 pages with fifty-four illustrations

<sup>5</sup> *Surgical Errors and Safeguards*. 4th ed. By Max Thorek. Philadelphia, 1943. J. B. Lippincott. Price \$15.00.

<sup>6</sup> *A Surgeon's World*. By Max Thorek. Philadelphia, 1943. J. B. Lippincott. Price \$3.75.

<sup>7</sup> *The Genealogy of Gynaecology*. By James V. Ricci. Philadelphia, 1943. Blakiston Company. Price \$8.50.

has an index of personal names and an index of subjects. It is good reading.

Willard R. Cooke,<sup>8</sup> author of "Essentials of Gynecology," says in the preface, "The object of this book is to present concisely, from the practical viewpoint, and with as much correlation as possible, the salient features of the anatomy, pathology, symptomatology, and therapy of gynecology. In practice both diagnosis and treatment should be based as far as possible upon a knowledge of the norms and of the various anatomic and physiologic pathologic states; hence, in the arrangement of the subject material, an effort has been made to place the descriptions of the pathologic states immediately before the clinical discussions in order to facilitate such correlation." The author lives up to his blueprint and writes from his teaching and clinical experience. This book (474 pages) has 197 illustrations, ten of which are in color. Dr. Cooke, professor of obstetrics and gynecology at the University of Texas School of Medicine since 1925, is considered one of the best known men in his field in this country and has written a book worthy of his reputation.

"Gynecology with a Section on Female Urology," by Lawrence R. Wharton,<sup>9</sup> is another solid work on this subject. The author has succeeded in putting into simple and clear form the main facts about gynecology. He has distinguished between fact and fiction and has stressed established principles, and, in discussing unsettled problems has considered representative opinions, however divergent they may be. A good deal of space has been devoted to female urology. Whether one practices urology or not he must, if he is a gynecologist or an obstetrician, be familiar with the normal function and pathological changes in the female urinary system, the results of accidents, and in more than a general way know how to meet and handle these situations. We hope all textbooks in the future will give ample consideration to urological problems in connection with gynecology and obstetrics (a consideration of the lower bowel, anus and rectum might be dealt with, too, with profit).

This is a textbook. It is well designed for medical students. Teachers of this subject would do well to list this work as the main textbook to use or as a work for supplementary reading.

<sup>8</sup> Essentials of Gynecology. By Willard R. Cooke. Philadelphia, 1943. J. B. Lippincott. Price \$6.50.

<sup>9</sup> Gynecology with a Section on Female Urology. By Lawrence R. Wharton. Philadelphia, 1943. W. B. Saunders. Price \$10.00.

# The American Journal of Surgery

Copyright, 1944 by The American Journal of Surgery, Inc.

A PRACTICAL JOURNAL BUILT ON MERIT

Fifty-third Year of Continuous Publication

NEW SERIES VOL. LXIII

MARCH, 1944

NUMBER THREE

## Editorial

### SURGICAL RENAL TUBERCULOSIS

**I**NASMUCH as the latest statistics show that tuberculosis in general is on the increase since war created profound changes in living standards throughout the world, it is reasonable to expect that this increase will be observed in renal as well as in other forms of this disease. It is accordingly worth while to emphasize the importance of the early diagnosis of this condition, and the possibility of its complete eradication by surgical treatment, when it has reached the open stage.

Albarran, in the beginning of this century, was the first to introduce this principle of modern urology, pointing out that removal of the one kidney affected would result in complete cure. Although he had no urographic means of diagnosis, he was able, in the face of opposition and destructive criticism, to demonstrate by results that this principle was sound. His work in this field is essentially the basis of what we know today of the solution of this fascinating problem.

Renal tuberculosis, which is a blood-borne infection from some other primary focus, is unilateral in 80 to 90 per cent of cases, the original lesion being in the lungs, lymphatics or bony system, in which it may have become quiescent but has later produced manifestations in the kidneys or genitourinary tract. Once in

this tract, it falls into two main groups, the one medical, or closed, the other, surgical, or open. The medical group comprises the cases of miliary tuberculosis and tuberculous nephritis, both characterized by presence of tuberculous bacilluria. So long as the lesions remain closed, that is, isolated within the renal parenchyma and expressed only in a bacilluria, without other symptoms in the urinary tract, they may heal. Such cases do not require surgical treatment. Once they have opened into the excretory apparatus, however, no treatment will be effective except nephrectomy. It is these open cases which constitute the recognized entity of tuberculosis of the kidney. It is called surgical renal tuberculosis because its only cure is by surgical means. By the time a case becomes open, the pathologic process is well established and has destroyed the parenchyma of the kidney, forming typical caverns such as are seen in pyonephrosis. The kidney as a rule drains its caseous contents into the calices, renal pelvis and ureter, producing pyuria, hematuria, and other marked urinary disturbances, characterized by bladder symptoms for which the patient is referred for urological consideration.

The diagnosis is readily made in these urographic days, and is based on (1) cystoscopic data, (2) catheterization of

both ureters in the differential renal test, (3) roentgenographic and pyelo-urographic evidence of a well established lesion, and (4) laboratory data based on positive smear for Koch's bacillus in the urine, or positive culture, or positive guinea pig inoculation. With these fundamental data one is in a position to establish a correct diagnosis for renal tuberculosis. Upon these data and the verification of a normal pyelogram of the kidney of the opposite side, one may always feel assured that the indication is present for nephrectomy of the diseased kidney.

In the surgical management of renal tuberculosis it is also important today to consider not only the pathologic condition of the kidney, but also the surgical lesions that may involve the ureter and urinary bladder, which will demand further treatment. There are two types of surgical renal tuberculosis with lesions of the ureters which can be established urographically previous to operation. The first is the type of hydro-ureter, or megaloureter, or the ureter in which there is a vesico-uretero-renal reflux. The second is the group of cases in which the ureter is infiltrated, with marked urteritis, and indurated to such an extent that it can be detected by rectal or vaginal palpation. In these two types, demonstrable before operation, a combined ureteronephrectomy by two separate incisions is the procedure of choice. In those instances, however, in which an advanced lesion of the ureter has not been properly recognized in advance, and is discovered only in the course of a nephrectomy, the lumbar incision should be prolonged to include a ureterectomy. This total and radical procedure is simple, and assures a permanent cure. It is important, from a surgical point of view, to emphasize that if the ureter is not removed *in toto* when it is tuberculous, it may produce a uropurulent lumbar fistula, or a persistent cystitis, which will demand a subsequent secondary ureterectomy. Electrocoagulation or fulguration of a tuberculous ulcer of the

bladder will be useless if the stump of a tuberculous ureter has not been removed at the time of the nephrectomy. In the past, many failures following nephrectomy have been attributable to this oversight on the part of the surgeon who has not removed this tuberculous focus, which inevitably infects the bladder and may also cause ascending infection of the other kidney.

In the surgical problem of bilateral renal tuberculosis, present in 10 to 20 per cent of cases, we are again confronted with two principal types: In one of these the pyelographic data and differential renal functional tests reveal destruction of the papilla, calices and renal parenchyma, while the urographic studies of the kidney of the opposite side show that this organ is still normal, even though the catheterized specimen discloses an excretory tuberculous bacilluria. Here nephrectomy is obviously indicated. In the other group, the destructive pathologic process is far advanced and can be demonstrated in the retrograde pyelogram of both kidneys. In such cases no surgery seems to be indicated, except in those in which a large pyonephrotic kidney is present, which calls for drainage by a simple lumbar nephrostomy, to relieve symptoms and prolong life. This principle also applies in the exceptional case of an acquired single kidney in which the tuberculous disease is far advanced.

It is well to emphasize that the sulfa drugs, which have come to be regarded as a panacea for all infections, have no effect upon the tubercle bacillus. For this reason a persistent pyuria and dysuria, with marked nocturia and bladder tenesmus, should be promptly investigated from the urological angle without wasting time in the use of these new chemotherapeutic measures or other forms of palliative treatment.

It should be borne in mind, however, that nephrectomy is only the first step in the general management of tuberculosis of the kidney. After operation the patient

must be submitted for a considerable period of time to a proper dietetic regimen, suitable hygiene, medical care and rest, preferably in the quiet of a sanatorium, in order to build up bodily resistance against the toxins of the Koch bacillus, which may still be present in the lungs or blood stream. There will be no permanent cure of renal tuberculosis until the primary focus within the kidney has been removed. The few isolated cases that have been reported of so-called healed tuberculosis of the kidney are not convincing, since in most of these the malady has recurred with all its annoying bladder symptoms; and in some there has been anatomopathologic proof at autopsy of the persistence of the tuberculous lesion in the kidney. Even in cases of so-called autonephrectomy or complete calcification or caseation of the whole organ, in which the patient has gained in weight and strength temporarily, the specimen removed at operation has revealed actual caverns and obviously active tuberculous lesions.

The convenience and facility of spinal anesthesia, the improvement in surgical technic and in the pre- and postoperative care of these tuberculous patients have all contributed to the lowering of the morbid-

ity and mortality, and have assured better curative results.

The curability after nephrectomy is high, the operative mortality very low, depending of course upon the condition of the patient, the stage of the disease and whether the primary lesion in the kidney is unilateral or bilateral. The prognosis is on the whole excellent with this train of treatment for obtaining a permanent cure.

In addition it can be said that the surgical treatment of renal tuberculosis offers to the community and to the world at large a better control of the propagation of this age-long scourge of humanity, removing a source of contamination for which medical science has as yet found no specific cure.

The enormous experience and abundant clinical data which have been accumulated in this accurate cystoscopic and urographic era prove the sound wisdom of establishing in renal tuberculosis an early diagnosis, followed by an early nephrectomy. For the discovery and application of this principle, which is one of the greatest achievements of modern urology, we are forever indebted to its originator, the great Albaran.

ROBERT GUTIERREZ, M.D.



# Original Articles

## CANCER OF THE LIP\*

A STUDY OF FIFTY-SIX FIVE-YEAR CASES

C. A. WHITCOMB, M.D.

PHILADELPHIA, PENNSYLVANIA

THE term cancer of the lip is used here to mean a malignant neoplasm of the exposed margin of the lip, the part of the lip which is seen when the lips are closed, and of the regional lymph nodes of the neck. Cancer of the skin of the lip (Fig. 1A), of the mucous membrane of the lip (Fig. 1B), and of the labial commissure (Fig. 1C) are not included in the term because the course of these neoplasms is different. Cancer of the lip is more malignant than cancer of the adjacent skin and less malignant than cancer arising from the mucous membrane of the lip and from the labial commissure.

Cancer of the lip occupies a unique position among malignant tumors. No tissue of the body affords the oncologist better opportunity to observe all phases of the behavior of malignancy. Cancer of the lip was the type of malignancy first used by Broders to correlate the degree of anaplasia of cancer (the histological grade), and the result of surgical treatment. It is sufficiently malignant to present all of the therapeutic problems of cancer, yet not so malignant as to prevent sound treatment producing encouraging results. Cancer of the lip is also a type of malignancy which is particularly favorable for the reduction of cancer mortality and is suitable for demonstration to laymen of the curability of cancer.

Cancer of the lip is a dangerous disease. This statement would be a platitude if it were well known to all men of sixty and

remembered by all physicians. Many patients are not concerned by the insignificant, painless spot on the lip, and some doctors cannot yet resist the temptation to burn or cut, in their offices, a small primary cancer of the lip. Such physicians do greater harm by failure to follow up the disease and to warn the patient of the possibility of metastasis of the lymph nodes of the neck.

Cancer of the lip, after cancer of the skin, is the commonest type of malignancy occurring in men; 148 men were treated for squamous carcinoma of the skin of the face during the period in which fifty-six men were treated for cancer of the lip. Cancer of the lip is very infrequent in women and on the upper lip. Of the fifty-six cases which were studied, all were men; fifty-five cancers arose from the lower lip, one from the upper lip. (Fig. 2A.) The constancy of these findings excites one's curiosity regarding the etiological part played by sex and site. Most patients are old. The average age of the fifty-six patients was sixty-five years; the extremes of age in the group were thirty-five and eighty-five years.

Some patients state that the cancer began as a fever-blister, sun-poisoning or a trivial injury. The cause of cancer of the lip is not known, but leucoplakia and syphilis, when present, play a part in its course. All authors agree that cancer of the lip may arise in a patch of leucoplakia, a condition of undetermined con-

\* From the Jeanes Hospital, Philadelphia, Pennsylvania.

stitutional background. The relationship between syphilis and cancer is not clear, but experience convinces one of the seriousness of the co-existence of the two diseases. Eight of the fifty-six patients had tertiary syphilis; three of the eight had signs of involvement of the cerebrospinal nervous system.

Cancer of the lip is a squamous carcinoma which, according to Broders' method of classification, is usually grade I or II. The grades of the fifty-six cases of squamous carcinoma studied were: grade I—thirty-two cases; grade II—seventeen cases; grade III—five cases; grade IV—no case; two cancers were not graded. (Table II.) This distribution of grades is similar to that of larger series of cases reported by Taylor,<sup>1</sup> by Martin,<sup>2</sup> and by Schreiner.<sup>3</sup>

Most of the interest in the histology of lip cancer centers about the usefulness of the grade of the cancer as a guide to the choice of surgical or radiation treatment. Broders<sup>4</sup> concluded that routine suprahyoid neck dissection was unnecessary in grade I cancer of the lip because cancer of that grade did not metastasize. However, thirty-two of the fifty-six lip cancers studied were classified as grade I; metastasis occurred in eight of these thirty-two cases (Table II), an incidence of 25 per cent, which is the approximate percentage of metastasis in large series of cases of all grades.

The different incidence of metastasis from grade I lip cancer in this group of fifty-six cases and in that studied by Broders is, apparently, explained in part by the difference of opinion among pathologists regarding the grade of a particular squamous carcinoma.

Cancer of the lip is not a painful disease; few cancers become tender. Lip cancer, as a rule, grows slowly. The average duration was eleven months in fifty-six patients, but the rate of growth varies in different patients and in the same patient at different stages of the disease. The duration of cancer is a guide to the intelligence and social status of the patient. The younger, intelligent patient seeks cancer treatment

in two or three months, but the senile patient may wait two years.

A very early cancer of the lip appears

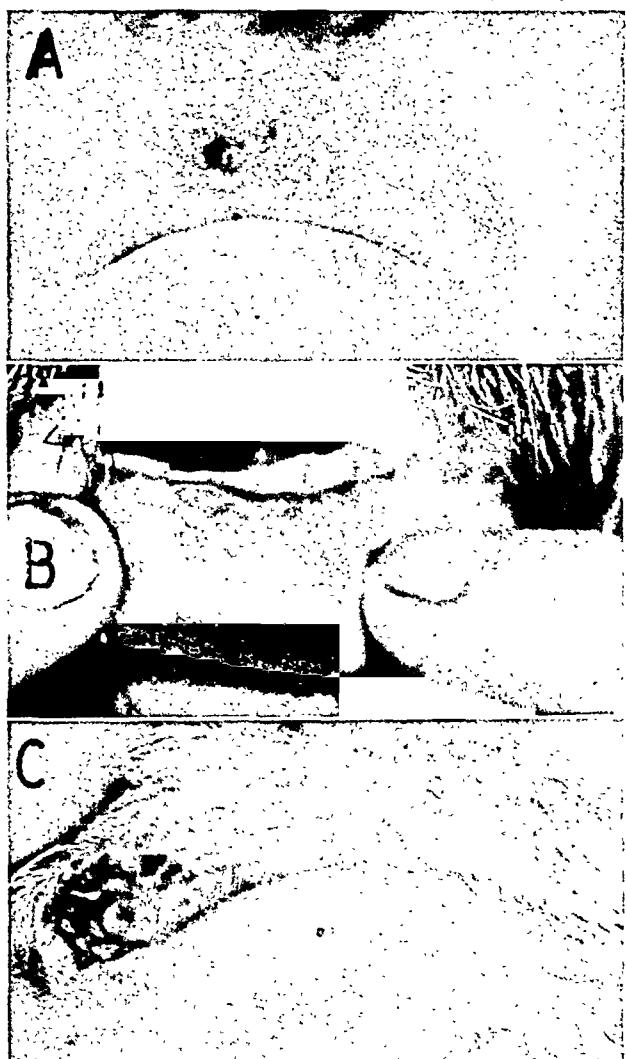


FIG. 1. Neoplasms of tissues adjacent to lip; not included in the term "cancer of the lip." Retouched photographs. A, basal cell carcinoma of skin of upper lip (woman); B, squamous carcinoma grade II of the mucosa of the lower lip; C, squamous carcinoma grade I of labial commissure; involving the mucosa of the cheek.

as a clean, red, finely granular, oval erosion (Fig. 2B) outlined by an elevated margin of normal mucosa visible only by oblique light. Stiffness characterizes the erosion as cancer. The elevated margin is formed by the submucosal growth of cancer. As the cancer enlarges, the oval shape and the elevated margin are retained. Though the skin, the muscle and the mucous membrane of the lip are involved to some extent by continuity, cancer of the lip tends to respect these tissues. In some cases the

TABLE I

RELATION OF SIZE OF LIP CANCER TO INCIDENCE OF METASTASIS AND TO 5-YEAR SURVIVAL

	Size of Lip Cancer					
	2 cm. or Less	2-4 cm.	Over 4 cm.	Multiple Cancers	Size Unknown Destroyed be- fore Admission	Total
Number of Patients.....	31	9	6	4	6	56
Metastasis						
Present at some time.....	4	5	2	3	6	20
Percentage present at some time.....	13	55	33	75	100	36
5-Year Survival						
Number of patients.....	26	3	2	1	0	32
Percentage of patients.....	84	33	33	25	0	57

TABLE II

RELATION OF GRADE OF LIP CANCER TO INCIDENCE OF METASTASIS AND 5-YEAR SURVIVAL

	Grade of Squamous Carcinoma					
	I	II	III	IV	Not Graded	Total
Number of patients.....	32	17	5	0	2	56
Metastasis						
None at any time.....	24	8	2	..	2	36
Present at some time.....	8	9	3	..	0	20
Per cent present at some time.....	25	55	60	..	0	35
On admission.....	3	2	1	..	0	6
On admission—lip cancer destroyed.....	1	3	2	..	0	6
After admission.....	4	4	0	..	0	8
5-Year Survival						
Number of patients.....	23	6	1	..	1	31
Percentage of patients.....	71	35	20	..	50	55

TABLE III

RELATION OF CERVICAL METASTASIS TO 5-YEAR CURE

Metastasis	No. of Patients	Lived 5 Years		Died before 5 Years			
				Total No. Dead	Cancer		No Cancer
		No.	Per Cent	No.	No.	Per Cent	No.
None at any time.....	36	30	83	6	0	0	6
Present at some time.....	20	3	15	17	17	100	0
On admission.....	6	1	16	5	4	80	1
On admission—lip cancer destroyed.....	6	0	0	6	6	100	0
After admission.....	8	2	25	6	4	66	2
Stage II.....	13	3	23	10	10	100	0
Stage III.....	7	0	0	7	7	100	0

cancer cells of the erosion multiply to form a smooth or cauliflower nodule (Figs. 2c and 3e) which may or may not ulcerate

2e) produces a hard, thickening of the deep tissues of the lip which has a relatively normal surface. In a more advanced

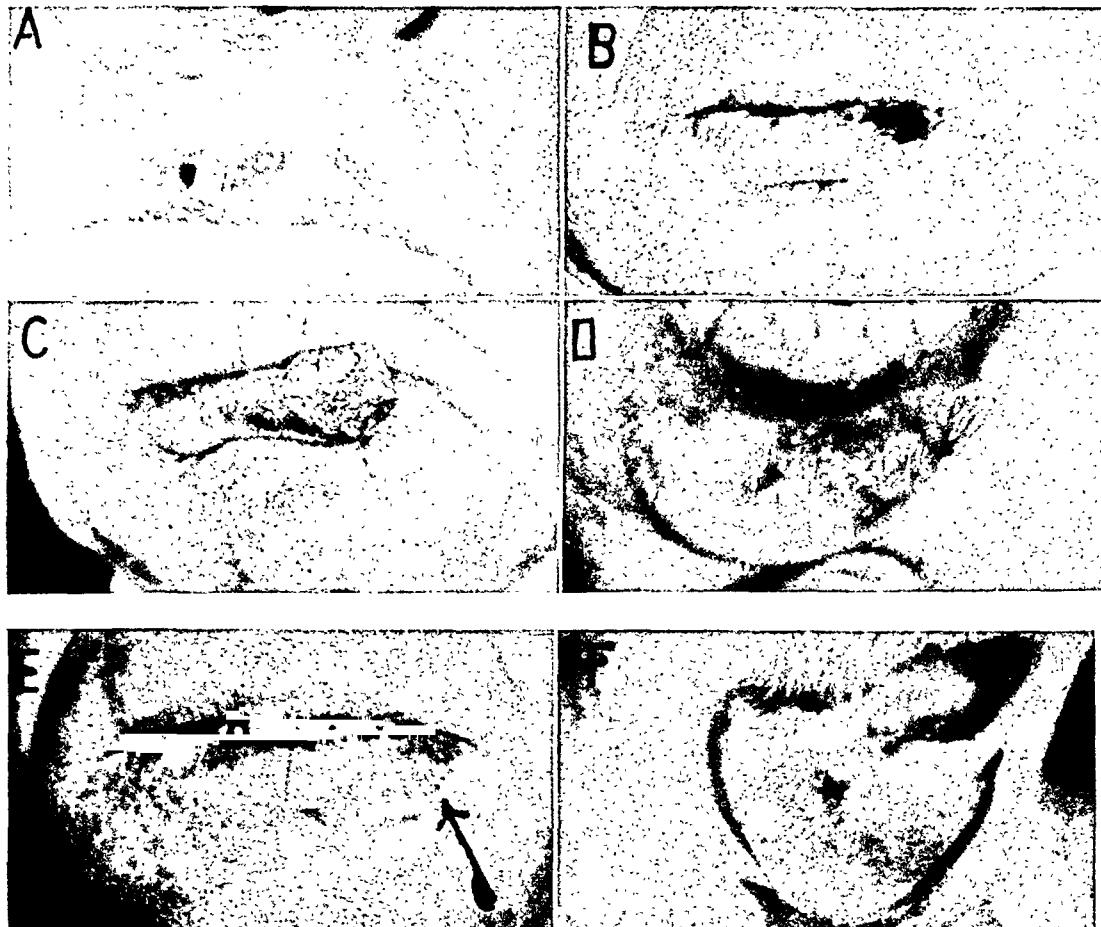


FIG. 2. Clinical types of squamous carcinoma of the lip. A, grade I; upper lip; died six and one-half years later from adenocarcinoma of the rectum; B, grade I, indurated erosion; common type; associated with incurable cervical metastasis shown in Figure 5; C, grade II; large warty nodule associated with leukoplakia of the lip; D, grade I; soft superficial irregular ulceration; E, grade I; infiltrating type, early stage; F, grade III; infiltrating type, later stage, involving tissues of the chin. The margin of the cancer is indicated by the ink mark on the skin.

(Fig. 3c, d) or the cells die, thereby forming an ulcer with loss of the contour of the lip. (Fig. 3b:)

Another clinical form of cancer of the lip occurs in older men who have had leukoplakia of the lip off and on for years. (Figs. 2c and 3f.) One or several small or large gray, scaly, or warty cancers may co-exist with patches of leukoplakia, the combination often extending the length of the lip. Leukoplakia may be the source, over the years, of a series of small, independent cancers which are not to be confused with recurrent cancer.

A less common and more dangerous kind of cancer, the infiltrating type (Fig.

stage (Fig. 2f) the hard area of the lip extends downward to form a diffuse, hard swelling of the soft tissues of the chin which is covered by normal skin. The periosteum of the symphysis of the mandible may be involved by inflammation or cancer.

Metastasis to regional lymph nodes appears in approximately 25 per cent of a series of cases of cancer of the lip. This figure is obtained by compiling the figures of large series reported by Taylor,<sup>1</sup> Martin,<sup>2</sup> Schreiner,<sup>3</sup> and other authors. Of the fifty-six cases studied, twenty had metastasis; twelve on admission (six of which were referred for treatment of cervical

metastasis only) and eight developed metastasis after control of the primary cancer. (Table III.)

The first and frequently the only metas-

one month to two and one-half years; the average interval was twenty months. The interval averaged eleven months in the nine patients who developed metas-

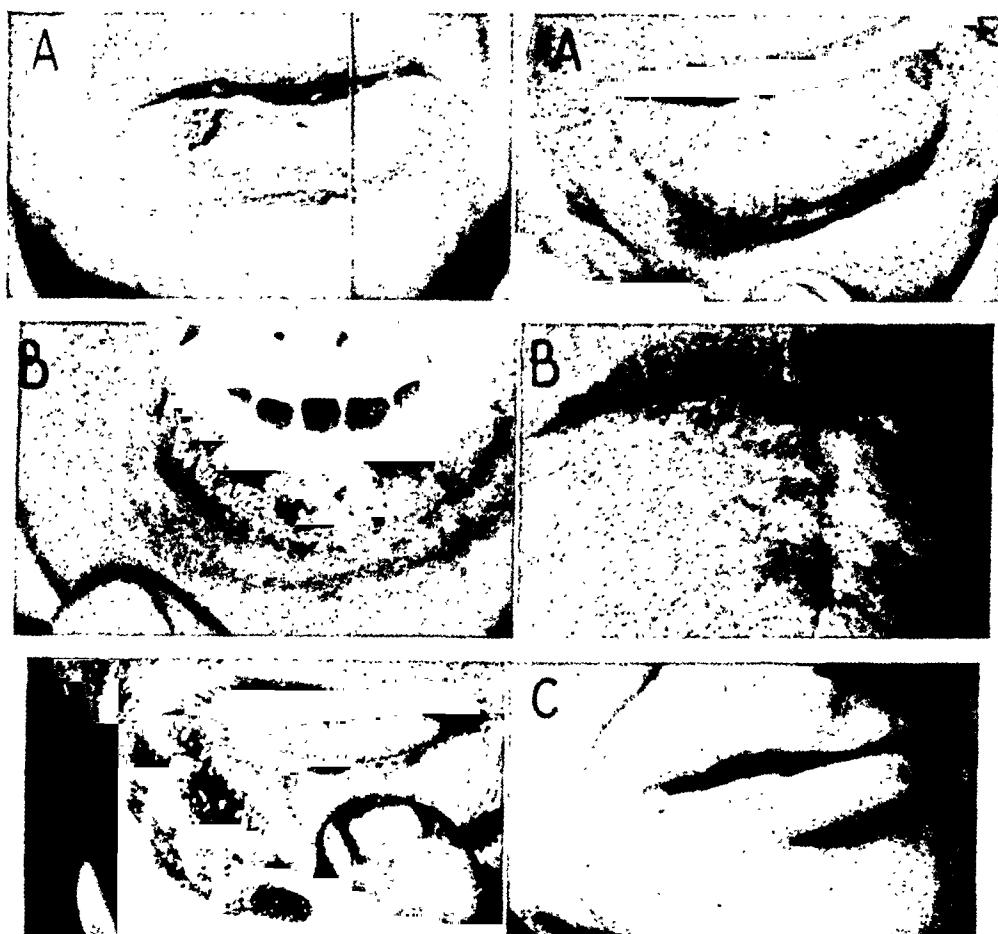


FIG. 3. Squamous carcinoma of the lip; before and after treatment. A, grade I; treated with radon applicator; B, grade II; treated by v-excision; C, grade I; treated with radon applicator; D, grade I; treated by v-excision; poor healing; luetic; E, grade II; treated by excision and plastic; Est-

tasis involves the lymph node overlying the submaxillary salivary gland on the same side as the cancer of the lip; this occurred in seven of the twenty patients in this series.

An additional metastatic node was found in the following regions: the opposite submaxillary triangle (bilateral metastasis)—five cases; submental triangle—three cases; and carotid triangle—five cases.

The interval of time between the appearance of lip cancer and the discovery of metastatic lymph nodes in the twenty cases of metastasis studied varied from

tasis after treatment of the lip cancer; the shortest interval was three months and the longest twenty-six months. The long interval of two and one-half years proves the need of a prolonged period of follow-up examination.

Metastatic cancer cells may remain confined for months to a single submaxillary lymph node which may reach a diameter of several centimeters without invasion of the overlying skin (Fig. 4A). Many of the largest metastases ever found in the neck are produced by cancer of the lip. Such a large metastatic node distends

the walls of the submaxillary space, overrides the margin of the mandible and elevates the floor of the mouth from which it is separated by the salivary

Thoracic or abdominal metastases were found in only three of seventeen post-mortem examinations made following death from cancer of the lip.

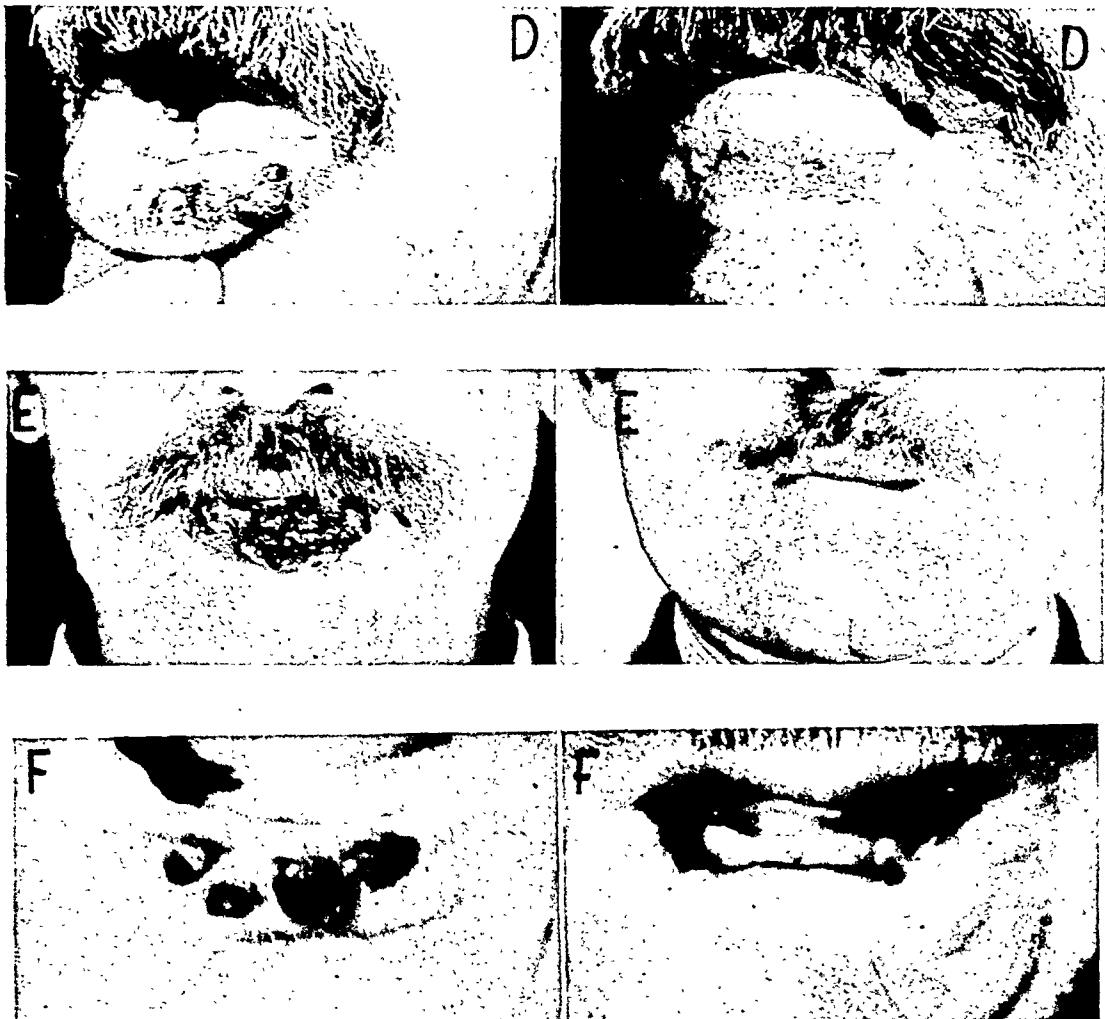


Fig. 1. D, E, Ulcer on upper and lower lips; F, G, Lander triangle flap from right half of upper lip; F, grade II; multiple cancers treated by excision of the entire exposed portion of lower lip.

gland. The metastasis may adhere, but not invade the periosteum of the margin of the mandible. Erosion of the margin of the jaw is occasionally seen in the x-ray film and very rarely the infiltrating type of lip cancer extends through the dental canal to the infratemporal fossa.

The incidence of visceral metastasis from squamous carcinoma of the lip is so low that the probability of visceral metastasis may be dismissed when one is judging a case. Metastasis of the viscera almost never occurs except in hopelessly advanced cases of cancer of the lip.

#### DIAGNOSIS

Failure to diagnose cancer of the lip in the early stage is almost always due to the patient's indifference to a chronic, symptomless lesion, and not to an error of the family physician who is more apt to diagnose cancer when none is present. The diagnosis is usually easy, yet small, stationary, symptomless lip cancer can be overlooked even in the presence of a large cervical metastasis. (Figs. 2B and 5.) Keratosis may co-exist and be difficult to differentiate from the scaly type of

cancer. A chancre of the lip and an indurated erosion due to cancer may look and feel alike, but the history and type of

node is called a stage II metastasis. It is presumed that fixation always indicates invasion of the surrounding tissues



FIG. 4. A, on admission, submaxillary metastasis, stage III, from small cancer of the lip previously destroyed by "acid." The crusts of the skin were produced by x-radiation prior to admission; B, three months after neck dissection; patient died without signs of cancer two and one-half years after operation.

patient are different. A positive Wassermann reaction does not identify the lip lesion as leutic. Cancer may arise in the lip or any other tissue in a patient with syphilis. The clinical diagnosis of cancer, with or without a positive Wassermann reaction, must always be confirmed by examination of a biopsy specimen, particularly if radiation treatment is chosen.

A hard, spherical, movable mass just below the point where the facial artery crosses the margin of the mandible, or just below the jaw margin in the midline, is usually a lymph node enlarged by the growth of cancer cells if it measures a centimeter or more in diameter. Microscopic examination of surgical dissection specimens, reported by many authors, proves that the correct diagnosis of metastases of nodes smaller than 1 cm. is luck, as there is a 50 per cent chance of error in diagnosis; lymph nodes which are not felt may contain cancer and small palpable nodes may be free of cancer. If found in any other part of the neck than the suprathyroid region, a single, spherical mass is rarely, if ever, a metastasis.

Fixation is the accepted criterion for classification of metastasis by stages and in relation to operability. A fixed node is called a stage III metastasis; a movable

by cancer. Fixation of a large submaxillary metastasis, not uncommonly associated with cancer of the lip, cannot, however, be accepted as evidence of invasion with the same assurance as fixation of nodes in other parts of the neck. It is probable that a benign submaxillary mass of the same size would be quite as fixed. An opinion regarding invasion and operability of this type of metastasis must, therefore, rest in part upon the rate of growth of the metastasis, the type and rate of growth of the lip cancer, the x-ray appearance of the jaw margin, the existence of invasion of the overlying skin, the presence of a palpable node margin, and the existence of the slightest degree of mobility of the suspected mass. Unquestionable invasion of the tissue surrounding a metastatic node appears as a diffuse, hard swelling, similar to a cellulitis.

Before any type of treatment for metastasis is given a biopsy specimen from the suspected mass must show cancer. A biopsy specimen may be aspirated with a needle and syringe, cut with a Silverman needle, or excised with a knife. Microscopic diagnosis is needed to prove the presence of cancer; it is decidedly in the interest of the patient's welfare.

## TREATMENT

Cancer limited to the lip has been successfully treated by surgery, x-ray, radium or electrosurgery, as well as by less approved methods. Any of the approved methods of treatment can be used to destroy a lip cancer; success depends upon the skilfull use of the method not on the method alone. Unless there is invasion of the mandible, the successful destruction of any lip cancer, irrespective of size, offers no therapeutic problem. The entire lower lip can be removed, if necessary, without impairment of the patient's health, even if the resulting defect is not closed by plastic surgery. However, before treating a small lip cancer as a trivial condition, one should remember that an insignificant lip cancer can produce large, incurable, cervical metastasis. (Figs. 2B and 5.)

The method of treatment chosen for a particular cancer of the lip depends upon the certainty with which it controls cancer, upon the rapidity of convalescence from treatment, and upon the cosmetic result. The method also depends upon the skills of the attending physician and the treatment facilities available to him. For the best cosmetic results small cancers of the lip should be excised and large ones treated by radiation.

Surgery is a more certain method of treatment for cancer of the lip than radiation because it does not depend for its success upon the unpredictable biological reaction of tissues to radiation, called radiosensitivity. Excision of a v-shaped piece of the entire thickness of the lip surrounding the cancer is a good type of treatment for a small cancer, not because it removes the lymphatics, but because the wound can be neatly closed and the cosmetic result is excellent. (Fig. 3B.) An operation consisting of the removal of the entire exposed portion of the lip alone (Fig. 3F) is suitable for treatment of small cancers and associated keratoses. If a fungating cancer which occupies

most of the lip is excised, the resulting surgical defect of the lip must be closed by some kind of plastic operation, such

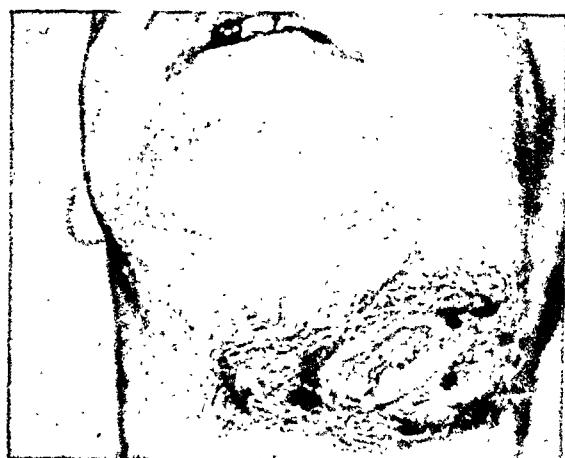


FIG. 5. On admission; diagnostic error; submaxillary metastasis; stage III; treated as an abscess; secondary to an unrecognized cancer of the lip shown in Figure 2B.

as the use of Estlander's triangles (Fig. 3E), or cheek flaps. Surgery would appear to be a decidedly better type of treatment than radiation for the infiltrating type of lip cancer which invades the soft tissues of the chin. (Fig. 2F.) Stewart<sup>5</sup> devised an operation for this type of lip cancer in which the lip, soft tissues of the chin and suprathyroid lymph nodes are removed in one piece.

The lip cancer was excised in forty-one of the fifty-six patients studied; nine were successfully treated by radium and one by radium and surgery. Five cancers of the lip had been destroyed before admission.

## TREATMENT OF CERVICAL METASTASIS

Prophylactic treatment of the lymphatics of the neck by surgery, or x-ray is not necessary because most cancers of the lip do not develop metastatic nodes. Follow up examination of the neck is a more ideal form of treatment.

Treatment of the metastasis is the important therapeutic problem in about 25 per cent of the cases of lip cancer. Although x-radiation is often used prophylactically and therapeutically, there are few reports except that of Martin<sup>6</sup> of five-year cures of microscopically proved

squamous carcinoma of the cervical lymph nodes by radiation of any kind. Squamous carcinoma of lymph nodes, secondary to

by a therapeutic dosage of radiation are a contraindication to subsequent surgical dissection. The use of any kind of post-

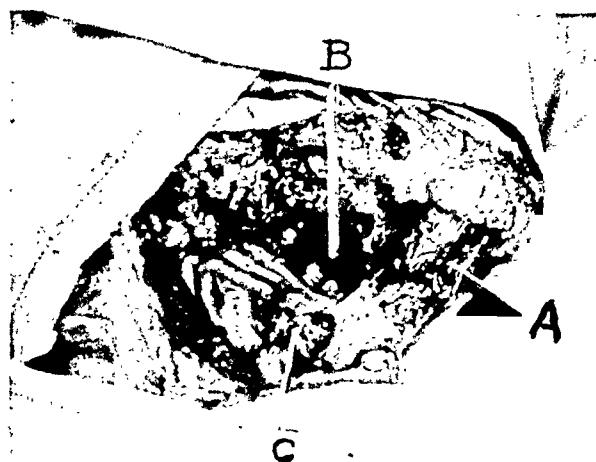


FIG. 6. Suprathyroid neck dissection (right side of bilateral operative field). Type of operation suitable for metastasis in submental or submaxillary triangle. A, submental triangle, anterior belly of digastric muscles on either side; B, submaxillary triangle, anterior and posterior belly of digastric muscle below, margin of mandible above; C, carotid triangle, omohyoid muscle in front, sternomastoid muscle behind.

cancer of the lip, is almost never destroyed by the maximum amount of  $x$ -radiation which the skin will tolerate. Martin usually supplements  $x$ -radiation with the implantation of radon seeds. The amount of radiation furnished from these combined sources will probably destroy squamous carcinoma in lymph nodes or elsewhere in the body and will produce some five-year cures in that class in which the metastasis is forever limited to one or possibly two nodes of moderate size. The success of the method depends upon the non-appearance of new metastatic nodes in the implanted area and lower in the neck. In this method of treatment a cancerocidal dosage of radiation is limited to the palpable metastatic nodes and is not given to a margin of normal lymphoid tissue. Martin's method, and that of Evans,<sup>7</sup> which consists of the implantation of radium needles throughout the entire side of the neck is indicated in patients who are poor surgical risks. The change in the tissues of the neck produced

operative radiation is indicated only in the cases in which the operability of the metastasis has been misjudged.

The removal of a margin of normal tissue surrounding any cancer is a fundamental principle of surgery. Intelligent application of this principle to the treatment of metastasis requires the recognition of all the metastatic nodes and the removal in one piece of the metastatic nodes and the normal nodes below those containing cancer. Enucleation or local excision of metastatic nodes is poor surgery. The field of surgical dissection is, therefore, determined by the location and extent of the metastatic nodes. The superthyroid dissection commonly performed is an operation limited to the submaxillary and submental triangles. It is a prophylactic operation inadequate for the control of cancer if metastatic nodes are present in these triangles. Metastatic nodes in the submaxillary or submental triangle require the dissection of at least the carotid tri-

angle of the same side of the neck (Fig. 6) to secure a surgical margin of normal lymph nodes and lymph vessels beyond the

Metastatic cancer which destroys bone is incurable by any method of treatment because it spreads rapidly even if destroyed



FIG. 7. Lateral neck dissection (left side). Type of operation suitable for metastasis in the carotid triangle. The posterior belly of the omohyoid muscle marks the lower limit of the field of dissection. A, submaxillary triangle of the neck; B, carotid triangle of the neck; C, occipital triangle of the neck (middle two-fourths); D, subcutaneous margin of the body of the mandible; E, digastric muscle, posterior belly; F, hypoglossal nerve, crossing the external carotid artery; G, internal jugular vein, ligated upper stump; H, carotid bifurcation with descendens hypoglossi nerve on its anterior surface; I, vagus nerve; J, upper stump of sternomastoid muscle and cut surface of parotid gland; K, region of the tendon of omohyoid muscle; L, position of lower stump of sternomastoid muscle and lower stump of ligated internal jugular vein.

metastasis. A certain percentage of failures will occur in any series of cases if a surgical margin of lymphoid tissue is not removed and if a lateral neck dissection (Fig. 7) is not done at once, if microscopic examination of the surgical specimen from the suprathyroid region shows unsuspected cancer in the nodes of the submaxillary region.

locally. But in some other types of stage III metastasis, the question of operability cannot be answered without meticulous examination and careful study of all aspects of the disease. Surgery may offer the patient with a stage III metastasis the best chance of survival.

When metastasis is confined to one large submaxillary node (Figs. 4A and B),

the slow growth of the metastasis, its low histological grade and its suprathyroid location, as well as the controllability of the lip cancer justify the performance of a neck dissection which would be contraindicated in a stage III metastasis from a primary cancer of any other site than the skin of the face. Fewer deaths will follow operation for large submaxillary metastases if a piece of the full width of the body of the mandible is not removed. Questionable areas of bone invasion can be charred with an electrocautery and the sequestrum allowed to separate.

Fortunately, bilateral submaxillary metastases from lip cancer are not necessarily simultaneous. A difference in the time of appearance of nodes on the two sides of the neck permits convalescence from one neck dissection before operation is needed on the other side of the neck. Bilateral neck dissection is probably more often done in conservative surgical clinics for metastasis from cancer of the lip than for metastatic cancer from any other tissue.

The treatment of the metastases which developed in twenty of the fifty-six patients studied, is as follows: surgery alone, twelve cases; surgery and x-radiation, four cases; surgery and radium, two cases; radium alone, one case; x-ray alone, one case.

#### PROGNOSIS AND RESULTS

Lip cancer, which never metastasizes, has an excellent prognosis; of the thirty-six patients studied, 83 per cent lived five years or longer. (Table III.) If the health of patients with this type of lip cancer were better, it would appear possible to attain five-year cure rates of 100 per cent.

Cervical metastasis is usually the cause of death from lip cancer. Table III shows a five-year survival of 15 per cent of the patients who had metastasis (stage II and III), and a five-year survival of 83 per cent of those who never had metastasis.

No single aspect of an individual lip cancer can be used as an infallible guide

to prognosis but, as a group, more patients with a small cancer (Table I) and with grade I cancer (Table II) lived five years. Small cancers (Table I) and grade I cancers (Table II) metastasize less often than lip cancers of high histological grade and those of large size.

The prognosis of metastases from cancer of the lip is better than that of metastases from cancer of the mouth or the throat. About one-fourth of the patients with movable, stage II metastasis, lived five years; three of thirteen patients, 23 per cent. Of the seven patients with fixed, stage III metastasis, none lived five years. (Table III.)

#### SUMMARY

Cancer of the lip is a slowly growing squamous carcinoma, grade I or II, of the exposed surface of the lower lip of aged men. Carcinoma of the upper lip and carcinoma of the lip of a woman are medical curiosities.

One lip cancer in four metastasizes to the cervical lymph nodes; visceral metastases are rare.

A large cancer or a cancer of high histological grade is more apt to metastasize than a small or low grade cancer, but metastasis of a particular cancer irrespective of size or grade cannot be predicted accurately.

Death is caused by uncontrolled neck metastases not by cancer of the lip itself.

X-ray, radium or surgery can be used successfully to destroy the cancer of the lip.

If the patient is cooperative, any kind of prophylactic treatment of the cervical lymphatics is unnecessary; follow-up examinations are preferable.

Movable metastatic nodes are treated, by choice, with block dissection of the cervical lymphatics.

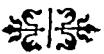
Fixation of large submaxillary metastasis from lip cancer is sometimes due to tension of the walls of the submaxillary space rather than the invasion of the mandible or floor of the mouth. This type of fixed metastasis is operable.

The cancer cells in lymph nodes can be destroyed by the combined effect of  $\alpha$ -radiation and radon implants, rarely if ever by external radiation alone; but the disease in the neck will be cured by combined radiation only if no new metastatic nodes develop in the implanted area or elsewhere in the neck.

## REFERENCES

1. TAYLOR, GRANTLEY W. and NATHANSON, IRA T. Evaluation of neck dissection in carcinoma of the lip. *Surg., Gynec. & Obst.*, 69: 484, 1939.

2. MARTIN, HAYES, MACCOMB, WM. S. and BLADY, JOHN V. Cancer of the lip. *Ann. Surg.*, 114: 226, 1941.
3. SCHREINER, BERNARD F. and MATTICK, WALTER L. Five-year end-results obtained by radiation treatment of cancer of the lip. *Am. J. Roentgenol. & Rad. Therapy*, 30: 67, 1933.
4. BRODERS, A. C. Squamous-cell carcinoma of the lip; a study of 537 cases. *J. A. M. A.*, 74: 656, 1920.
5. STEWART, J. CLARK. The radical treatment of epithelioma of the lip. *J. A. M. A.*, 54: 175, 1910.
6. MARTIN, HAYES. The treatment of cervical metastatic cancer. *Ann. Surg.*, 114: 972, 1941.
7. EVANS, W. G. and GRIFFITH, H. D. Dosage control of interstitial radium treatments by direct measurement of skin dosage-rate. *Brit. J. Radiol.*, 14: 377, 1941.



STREPTOCOCCI are Gram-positive organisms, which grow in chains and comprise many different strains. Also members of the same strain often develop varying degrees of virulence.

# DIAGNOSTIC VALUE OF BLOOD STUDIES IN MALIGNANCY OF THE GASTROINTESTINAL TRACT

H. LEONARD BOLEN, M.D.

Head of Department of Proctology and Gastroenterology, Fall River General and St. Anne's Hospitals  
FALL RIVER, MASSACHUSETTS

THE present study was undertaken with the primary objective of developing data which might furnish a valuable diagnostic adjunct in uncovering malignant disease of the gastrointestinal tract. Thirty selected cases were examined, seventeen in males, thirteen in females. In two instances the cancer was in the small intestine, seven in the colon, two in the sigmoid, one in the rectum, and eighteen in the stomach. The majority of the patients were in the older age group, and a number of specimens were obtained from each patient. In Table 1 the blood count, differential count, sedimentation rate and platelet count are recorded.

Examination of the blood smears in these cases failed to reveal any hematologic features that were unusual or in any way diagnostic of the existing condition. The majority of the patients presented an essentially normal blood picture, although abnormal cells appeared occasionally. In both early and late stages of malignancy, no significant changes were noted, except in those cases in which extensive ulceration had occurred. In these cases a distinct leucocytosis was found. The platelet counts were within normal limits, since the normal value for platelets, according to most hematologists, ranges from 200,000 to 400,000. Only two counts rose above this figure.

It was evident, however, that the blood sedimentation rate was abnormal in all cases. Also, the two-hour period was more reliable and, therefore, conclusions were based on the second reading. In these determinations a rate of 10 mm. for men and 15 mm. for women was considered the upper limit of normal. Lipp and Aaron<sup>1</sup> adopt the following scale:

Sex	Normal	Borderline	Elevated
Male.....	1-10	11-15	21+
Female.....	1-15	16-20	26+

Inasmuch as the rate was faster in solutions of fibrinogen, and slower in solutions of albumin, according to Fahraeus,<sup>2</sup> Broom,<sup>3</sup> and Lima and Brown,<sup>4</sup> the tests were also made with albumin. But in all of the experiments, the author found no change in the sedimentation rate; the results were the same as those obtained when the Cutler technique was employed.

In this series, as has been repeatedly noticed by other investigators, the analysis of the blood showed no striking characteristics. As Edwards<sup>5</sup> points out, if we assume the blood count to be an index of a patient's fitness, we may be sadly deceived. In many of the inoperable cases the red count and hemoglobin may remain rather high, or at least average normal:

"In a man of 49 with an inoperable growth, the red count was 6,560,000 and the hemoglobin 104 per cent, and in a woman with an inoperable growth it was 6,100,000 with 92 per cent hemoglobin. In fact, changes in the blood picture in cases of cancer usually differ very little from those of peptic ulcer."

The increase in the sedimentation rate, however, was of some significance, since it indicated that a disease of some kind was present. In 1927, Rubin<sup>6</sup> examined the blood sedimentation reaction in 127 cases of cancer and found this medium a better guide to the condition of the patient than the temperature chart. The progress of the disease was accompanied

by an increased sedimentation rate, although cachexia tended to retard it. The test, however, had no value in differential diagnosis because of its non-specificity and because early cancer produced little

of malignant disease. Further study has reëmphasized the fact that blood taken from a person suffering from cancer assumes a different picture from that taken from a normal person. After as-

TABLE I  
GASTROINTESTINAL MALIGNANCY

Sex	Age	Site	Hemo-globin (Sähli) Per Cent	Erythro-cytes	Leuco-cites	Neutro-philes	Small Lymph.	Large Lymph.	Sedimentation		Platelets (thou-sands)
									1 H.	2 H.	
M	39	Sigmoid	85	4.65	6,000	67	30	3	18	24	285
F	62	Colon	60	3.75	6,000	65	33	2	18	26	240
M	66	Stomach	60	3.70	10,600	68	30	2	20	28	245
F	62	Colon	50	3.25	9,000	74	25	1	26	34	240
F	58	Colon	70	3.60	8,000	65	33	2	24	30	265
F	53	Colon	70	3.60	7,800	66	33	1	21	29	300
F	78	Stomach	55	3.25	11,200	74	24	2	22	28	220
M	70	Stomach	80	4.65	6,200	68	25	7	24	30	240
M	73	Colon	55	3.55	11,000	86	12	2	24	32	250
M	61	Stomach	45	2.16	9,000	62	32	6	22	32	210
M	52	Intestine	70	3.85	20,000	94	6	0	18	24	280
F	72	Stomach	70	3.85	6,000	64	35	1	21	28	325
F	84	Stomach	75	4.50	12,000	76	21	3	24	32	400
M	64	Intestine	80	4.30	15,000	84	12	4	28	34	450
F	87	Stomach	50	2.75	7,000	78	20	2	22	30	340
M	51	Colon	50	3.50	11,600	80	18	2	24	28	290
F	72	Stomach	50	3.00	6,000	45	50	5	18	26	375
M	62	Stomach	80	4.30	11,000	85	12	3	16	24	400
M	68	Stomach	55	3.25	8,200	80	16	4	18	26	340
M	68	Stomach	50	3.50	24,000	90	5	5	20	28	300
M	73	Colon	75	4.25	13,000	90	8	2	24	28	370
M	71	Stomach	65	3.90	13,200	82	14	4	18	24	300
F	69	Stomach	40	3.15	12,000	85	10	5	18	22	290
M	70	Stomach	80	4.50	6,400	74	25	1	20	26	320
F	47	Sigmoid	60	3.25	7,400	60	35	5	24	32	375
F	67	Stomach	75	4.25	8,000	80	10	10	22	26	325
M	41	Stomach	70	4.10	7,200	72	25	3	18	26	300
M	70	Stomach	70	4.00	11,000	78	20	2	21	26	280
F	82	Stomach	80	4.50	19,400	90	5	5	22	26	300
M	59	Rectum	60	3.50	8,300	82	15	3	18	26	420

alteration in the velocity. It was noted that strictly normal sedimentation values were extremely rare in the presence of definitely diagnosed cancer. This is ascribed to physiochemical changes in the blood plasma and to the progressive anemia in cancer patients.

None of the factors listed above are specific for cancer. Therefore, we are forced to rely mainly upon the blood pattern, as described in a previously published article,<sup>7</sup> to reveal the presence

sembling many additional blood slides in conjunction with the clinical picture, it has now become possible to recognize a definite new pattern, that of beginning malignancy.

In preparing the drops of blood on the glass slide, lightness of touch is essential; for if the drops so acquired are too thick, no pattern is discernible. When the blood has dried satisfactorily, the pattern formed is a sensitive indicator and can be used at intervals to determine the course of the

disease, presence of metastasis, and end results after surgery, deep x-ray therapy, or radium implantation.

The clinical picture and physical signs should not be ignored in weighing the evidence. The condition of the patient

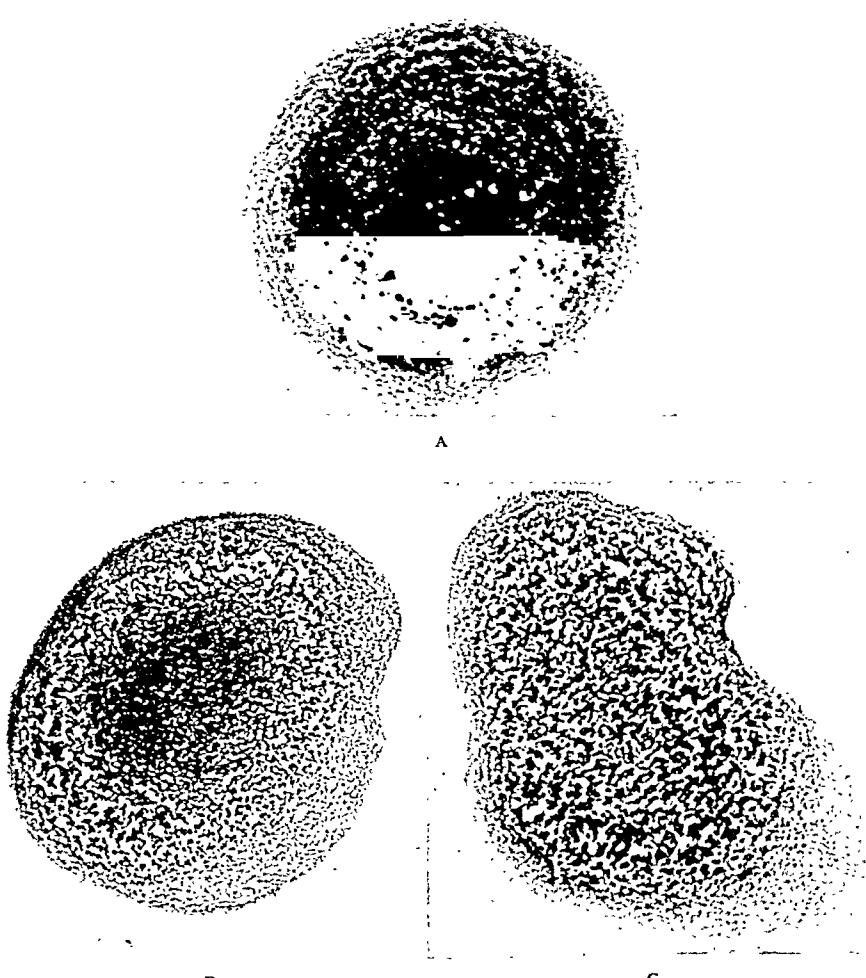


FIG. 1. A, normal pattern; B, pattern of early malignancy; C, pattern of late malignancy (gross appearance).

In Figure 1 we note three distinct patterns: A shows the normal blood pattern. The design is compact and in the central portion of the drop of blood is a dark agglutinated spot or nucleus. B shows the pattern of early carcinoma, with a breaking-down of the pattern at the periphery. The small central nucleus is absent, and the central half is much darker than the outer portion of the sphere. C shows the definite cancerous pattern of the "dotted curtain" type, creating the appearance of ground glass. No central nucleus is visible.

appears to run parallel with the patterns on the slides. In the words of Gruner:<sup>8</sup>

"The state of the red cells gives more information about the state of the patient than almost any other part of the blood examination."

In this special description of the wet preparation of normal and cancerous blood the same picture is apparent as that noted in the dried specimens. In this monograph he stated that the work of the past twenty-seven years proved that the study of the blood cells as a diagnostic test gave results unsurpassed in accuracy.

The author has attempted to simplify the method of diagnosis by noting the blood pattern both macroscopically and microscopically. The photomicrographs of cancerous blood are the same as those noted by Gruner.

The microscopic examination of the normal pattern reveals fibrin formation well defined—a web-like pattern. Leucocytes are scarce and red cells are packed tightly. Rouleau formation is present with no variation in the size or shape of the corpuscles. Fibrin is plentiful and extended over the whole specimen.

In the early carcinoma pattern small areas of clear plasma are scattered throughout the specimen. A few granules may be seen but no blood cells. The fibrin meshwork is not so definite as in the normal pattern.

In the full-bloom or advanced carcinoma picture large areas of plasma are visible and no red blood cells. No meshwork is found but the picture is that of relatively thick islands or masses with sharply defined contour. Leucocytes are rarely seen. An abundance of small fibrin threads appears. Within the plasma small red and green granules are found. The outline of the red cells is obscured and no real rouleau formation can be noted. The change appears to take place in the fibrin, resulting in large areas of plasma devoid of red blood cells. Thus, from this study, three distinct blood patterns emerge:

1. *Normal*: characterized by the appearance of well formed fibrin strands varying in size and thickness and crossing one another in all directions so as to form a fibrin web enmeshing the corpuscles.

2. *Early carcinoma*: showing the change in fibrin formation and the presence of small areas of plasma without red blood cells.

3. *Carcinoma*: definite marked change in fibrin formation and the presence of large areas of plasma and absence of red blood cells. This pattern is constant in cases of malignancy and has no relationship to anemia when present.

The two following cases illustrate the efficacy of the blood pattern as a diagnostic aid. In Case 1 the first specimens

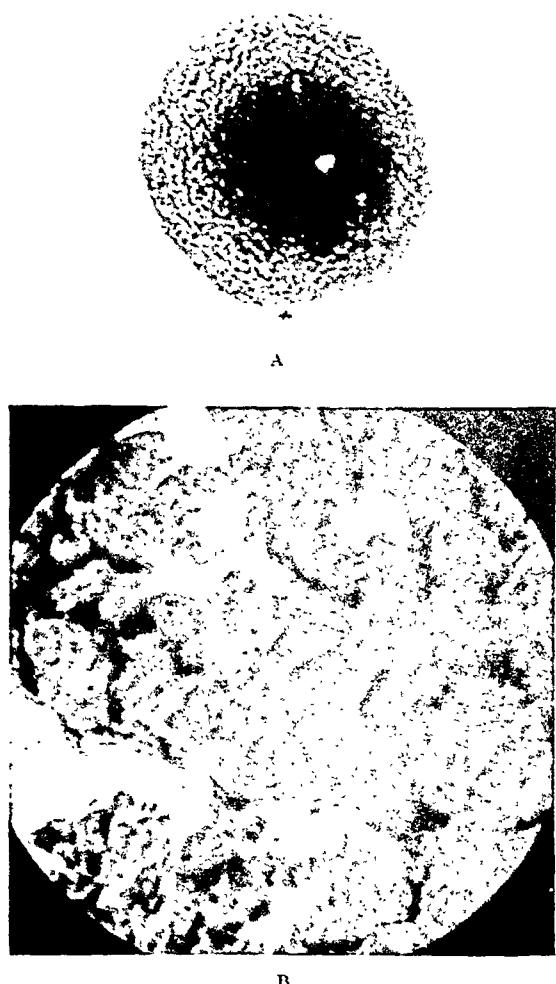


FIG. 2. A, adenocarcinoma of rectum, early stage; B, microphotograph of same drop of blood on slide. Note small lakes of plasma.

show early carcinoma and later on the full-bloom pattern. Many slides were made which show close correlation with the course of the disease until the final exitus.

**CASE 1.** J. O., male, age fifty-nine years, was admitted to the Fall River General Hospital May 2, 1942, with the complaint of pain in the abdomen for six months, accompanied by vomiting and diarrhea. There was generalized tenderness over the entire abdomen, most marked in both lower quadrants. Examination of the heart and lungs showed no abnormalities.

Urinalysis showed a specific gravity of 1.025, a slight trace of albumin and no sugar. Microscopically, the urine showed a very occasional

leucocyte and a red blood cell. Examination of the blood showed 60 per cent hemoglobin, 3,500,000 erythrocytes, 8,300 leucocytes with



FIG. 3. A, gross appearance of drop of blood, full-bloom carcinoma; B, microphotograph of same specimen. Note large areas of plasma with few blood cells.

82 per cent neutrophiles, 15 per cent lymphocytes, 2 per cent eosinophiles, and 1 per cent basophiles. The platelet count was 420,000. The blood sedimentation rate was 18 mm. in one hour; 26 mm. in two hours.

A drop of blood on the slide showed the pattern of early cancer. (Fig. 2A.) This specimen was taken May 8, 1942. At this time the breaking-down process at the periphery can be seen grossly. Under the microscope the lakes of plasma are seen shaping up. (Fig. 2B.)

A gastrointestinal series at this time showed poor filling of the duodenal cap with obstruction in the left side of the colon. Sigmoidoscopic examination showed a small elevation in the rectum about 5 cm. from the anus. This bled

easily. No tissue was removed for biopsy, but a tentative diagnosis of malignancy was made.

One month after admission an exploratory laparotomy was done and the entire intestinal tract examined. The small elevation noted on sigmoidoscopic examination could not be located. Instead, the mucosa of the colon showed several areas of diffuse ulceration and superficial hemorrhage. About 21 cm. of descending colon was resected and a colostomy set up. The pathological diagnosis of the specimen removed was chronic ulcerative colitis, non-specific; no evidence of malignancy was found.

On June 11th, examination of the blood showed 60 per cent hemoglobin, 3,600,000 erythrocytes, 6,600 leucocytes with 67 per cent neutrophiles, 30 per cent small mononuclears, 2 per cent large mononuclears and 1 per cent eosinophiles.

Attempts were made to close the colostomy during the patient's stay in the hospital. On November 11th, a small spur was clamped with three different clamps to the level of the lower end of the bowel canal. This cut through in three days. Then a large, soft, rubber No. 28 bladder drainage tube was placed *in situ*, one-half of the tube above and one-half below the colostomy. The tube was then connected by a suture of heavy silk to a small rubber tube on the rectal side brought out through the anus. On placing the latter tube in position, an annular constricting neoplasm was discovered in the rectum.

A drop of blood on the slide at this time, November 15th, showed the pattern of advanced carcinoma. (Fig. 3A.) The microphotograph of this specimen of blood shows great lakes of plasma. (Fig. 3B.)

On April 16, 1943, an abdominoperineal resection of the rectum was done. As a therapeutic measure, 15 gr. of sulfasuxidine was administered three times daily for about a week before operation was undertaken. It is interesting to note that peritonitis did not develop in the presence of degeneration, necrosis and drainage of feces into the peritoneal cavity.

The specimen removed consisted of about 10 cm. of terminal rectum containing the tumor mass. (Fig. 4.) The pathological diagnosis was adenocarcinoma of the rectum.

The patient went steadily downhill after this operation and died May 9, 1943. Many

blood slides were taken during this late stage of the illness and all showed the pattern of advanced carcinoma. The last of these slides was

and painless; periods lasted about seven days. For the past year, however, she passed blood almost continuously and the discharge was



FIG. 4.



FIG. 5.

FIG. 4. Specimen of adenocarcinoma of rectum removed April 16, 1943.

FIG. 5. Cyst of omentum removed April 23, 1943.

taken May 5th. Permission for a postmortem examination in this case could not be obtained.

It is interesting to observe that the pattern of early carcinoma appeared in the blood pattern on the slide at a time when surgical exploration of the gastrointestinal tract revealed no trace of cancer, and when the only condition found and confirmed by pathological examination was ulcerative colitis.

In this second case the blood pattern remained consistently negative, although clinical and x-ray evidence pointed strongly to malignancy.

**CASE II.** R. G., female, single, twenty-seven years old, a power sewing-machine operator, was admitted to a local hospital April 22, 1943, for abdominal pain and rectal bleeding. Except for an appendectomy in 1932, she stated that she had never felt ill until the present complaint. For the past year, however, she has passed quantities of blood rectally. Her bowel movements had been regular and she never needed catharsis. Menstruation was regular

profuse. During the past three weeks she had severe colicky pains and an impulse to move her bowels. When she strained, blood would gush out with relief of the pain for several days; then the cramp-like pain would recur. Bowel movements were normal. There were no urinary symptoms.

The general physical examination was negative except for slight tenderness and spasticity in the left inguinal region. Rectally, a soft, flabby mass was felt on the anterior wall of the rectum in the region of the pouch of Douglas. Sigmoidoscopy revealed a mass covered with mucous membrane. It was painful on palpation but did not bleed. By vaginal examination the mass was palpable in the posterior vaginal wall. The uterus and cervix were normal.

A gastrointestinal series, April 12th, was negative. A barium enema filled the large bowel completely. An oblique view of the rectal ampulla showed a smoothly outlined convexity, identified as the hard, tender, dome-shaped mass felt by the examining finger. The impression was extrinsic pressure defect in the anterior rectal wall (neoplasm or inflammation).

Urinalysis and blood examinations were negative. The stool contained no occult blood.

On the second day, under spinal anesthesia,

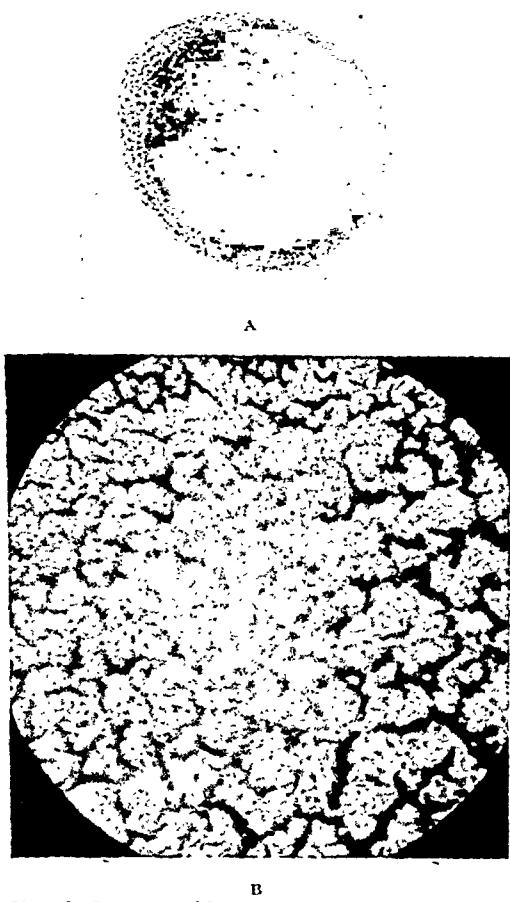


FIG. 6. Case II. A, blood pattern normal, April 22, 1943, before operation; B, microphotograph of blood pattern showing normal picture.

vaginal examination revealed the same findings. Dilatation of the cervix was attempted. It was found almost impossible to pass the smallest dilator through the cervical canal. This was finally accomplished, and a stricture or spastic area was noted about 3 cm. from the external os. The uterus was gently curetted, but the curettings were negative.

Exploratory laparotomy revealed the terminal portion of the omentum in the pouch of Douglas. In the omentum was found a serous, translucent cyst about the size of a large apple. (Fig. 5.) This was excised *in toto*. After this procedure manual examination of the rectum revealed a soft, slabby area in the rectum at the pouch of Douglas. A few postappendiceal adhesions were present. The ovaries were normal; there was a bilateral chronic salpingitis.

The pathological report of the specimen removed was simple omental cyst.

All specimens of the blood on the slides taken before and after operation were of the normal blood pattern. (Fig. 6A.) The microphotograph shows the closely packed red blood cells and rouleau formation and a substantial amount of fibrin throughout the specimen. Very few leucocytes are seen. (Fig. 6B.)

The change from a normal to a cancer pattern has not been explained through pathological or clinical investigation. The answer may lie in the behavior of the plasma. We know that it participates in many chemical reactions and maintains itself in constant acid-base equilibrium. It is adapted to every need of the body cells and tissues.<sup>9</sup> The changes in the plasma may be quantitative or qualitative or both. It is an interesting fact that during pregnancy there is an increased amount of blood and plasma present.<sup>10</sup> Dieckman and Wegner<sup>11</sup> also point out the fact that a high percentage of fibrin is found whenever foreign proteins enter the blood stream, as in cancer, infection, and nephrosis.

The same pattern is formed on the slide by cancer blood and by the blood of pregnant women. The change taking place in the blood during pregnancy has been observed from the first month on. Just before delivery the pattern is broken down to such an extent that the picture is typical of advanced carcinoma. Areas of plasma without blood cells are conspicuous. From the fourth day of the puerperium the blood begins to revert to normal. Each day the areas of plasma become smaller, strands of fibrin gradually begin to criss-cross in various directions throughout the field, and by the tenth to the twelfth day postpartum, the blood pattern is normal and remains so. This same return to normal is seen in cases of cancer in which total extirpation has been achieved, although the process takes about six weeks. Figure 7 shows the blood picture in pregnancy which both macroscopically and microscopically is identical with that seen in cancer. Figure 7A shows the typical cancer pattern (specimen was taken during the eighth month of preg-

nancy). Figure 7B was taken eight days postpartum. The blood pattern is still positive, but changes are beginning to

diagnosing cancer in various stages and to differentiate between benign and malignant conditions.

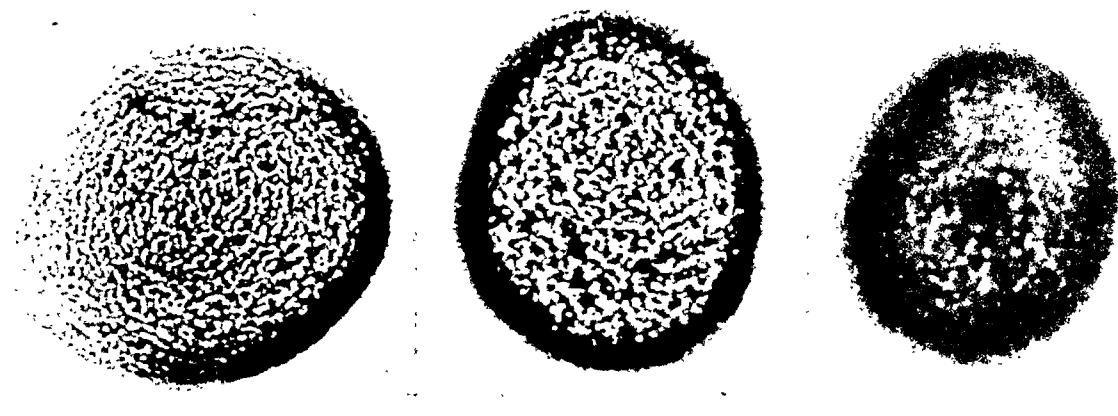


FIG. 7. A, pattern positive taken during eighth month of pregnancy; B, pattern still positive taken eight days after delivery; C, pattern normal taken two months following delivery.

occur at the periphery. Figure 7C, taken two months following delivery, shows the normal blood pattern.

Girón<sup>12</sup> tested 515 cases, consisting of 150 cancerous individuals and 365 non-cancerous patients and healthy subjects. In each case six drops of blood were examined—total number of drops of blood examined, 3,090.

In the cancerous patients, the typical cancer pattern was found in 90.4 per cent of the cases. In non-cancerous subjects the drop of blood showed the typical cancer pattern in 4 per cent of the cases.

In evaluating the results obtained, Girón states that they closely approximate the results obtained by the author of the test.

#### CONCLUSION

The accumulation of additional slides further substantiates the correlation between the blood pattern and carcinoma. The increase in the blood sedimentation rate is also of diagnostic aid but is non-specific and of only general significance. None of the other phases of the examination of the blood furnish a clue to the presence or absence of cancer. The small number of cases taken at random are typical. The blood pattern noted in a drop of blood on the glass slide continues to offer the internist substantial aid in

#### REFERENCES

- Lipp, W. F. and Axron, A. H. The sedimentation rate in gastrointestinal disease. *New York State J. Med.*, 42: 1951, 1942.
- Fahræus, R. The suspension stability of the blood. *Physiol. Rev.*, 9: 241, 1929; Ueber die Ursachen der verminderten Suspensionstabilität des Blutkörperchen während der Schwangerschaft. *Biochem. Ztschr.*, 89: 355, 1918; The suspension stability of the blood. *Acta med. Scandinav.*, 55: 1, 1921.
- Broom, J. C. The correlation between red cell sedimentation rate and plasma proteins. *J. Lab. & Clin. Med.*, 22: 698, 1937.
- Lima, S. N. and Brows, J. W. Sedimentation of erythrocytes in solutions of albumin, fibrinogen and peptone. *Proc. Soc. Exper. Biol. & Med.*, 35: 598-601, 1937.
- Edwards, H. Carcinoma of the stomach. *Lancet*, 2: 1132, 1938.
- Rabin, E. H. The sedimentation reaction in cancer. *Am. J. Med. Sc.* 174: 689, 1927.
- Bolles, H. L. The blood pattern as a clue to the diagnosis of malignant disease. *J. Lab. & Clin. Med.*, 27: 1522, 1942.
- Gruener, O. C. *A Study of the Blood in Cancer*. Montreal, 1932. Renouf Publishing Company.
- Adamson, J. D. and Hartley-Smith, F. The blood in pregnancy. *Cancer, M. A. J.*, 26: 679, 1932.
- Rowntree, L. G. and Brown, G. E. *The Volume of the Blood and Plasma in Health and Disease*. Mayo Clinic Monographs. Philadelphia and London, 1929. W. B. Saunders Company.
- Dickman, W. J. and Wiesner, C. R. Studies of the blood in normal pregnancy: percentage and grams per kilogram of serum protein and fibrin and variations in total amount of each. *Arch. Int. Med.*, 53: 353, 1934.
- Girón, M. A. Thesis—La Eritrosedimentación En Génes Grecas Como Guía En El Diagnóstico Del Cáncer. Guatemala, July, 1943.

# MODIFIED NON-ADHERENT GAUZE PRESSURE TREATMENT FOR BURNS

WALLACE MARSHALL, M.D.

Associate Professor, Department of  
Physiological Chemistry,  
Spring Hill College

AND

ELENA GREENFIELD, A.B.L.S.

MOBILE, ALABAMA

THE purpose of this study was to employ a modification of the Koch, Mason and Allen pressure treatment of burns with the use of a new ointment\* which would form a non-adherent coating over such wounds and would render the injury practically sterile. Various sprays and sulfa powders have been employed to form an eschar over such wounds, but these have proved to be rather painful and non-supple. Furthermore, it was our hope to evolve a simple treatment for burns which could be employed by the now undermanned hospital staffs. Also, the present study could serve as a postlude for the application of some principles which Marshall and Rosenthal<sup>1</sup> described in their recent study on the pathogenesis of keloids, since such new growths many times have their origin in burns, especially in patients of the colored race.

These investigators found that tissue fluid exudations, if allowed to remain in the tissue spaces as the result of injury, attract the fibroblasts which invade the injured area. Later on, the proliferation of scar tissue occurs. Previously, Marshall<sup>2</sup> had noted that vasoconstriction of wound areas tends to improve healing. This confirms the pressure gauze methods of Koch, Mason and Allen who have advocated a pressure compression bandage of vaseline gauze over burned areas to lessen the flow of tissue exudates. In some unpublished research, Marshall found that plain gauze, when fixed to the wounds of surgical patients by means of catgut stay-

sutures, tends to allow such wounds to heal more rapidly with the added feature of the formation of a supple non-keloid scar when the healing is completed, since this compression does not allow a tissue edema to remain in the surgical area.

The rôle of the sulfonamides in wound healing has been established, particularly in the prevention of wound infections. Sulfanilamide has the greatest solubility in the tissue fluids of all the sulfonamides. Sulfathiazole ranks considerably below it.

This new ointment, used in the course of the present study, contains 2 per cent allantoin with 5 per cent sulfanilamide and 5 per cent sulfathiazole. The material is water soluble and is miscible with the body fluids and releases these effective agents readily into the infected burn areas.

The solubility of sulfanilamide is such that in all probability it is depleted from the site of application within forty-eight hours. Since the process of redressing may interfere with adequate wound healing, and since the tiny capillary buds may be disturbed by such a procedure, the incorporation of sulfathiazole in the paste was completed. This additional ingredient would allow effective concentration of a sulfonamide over a much greater period than would be secured by sulfanilamide alone. This addition to the paste (sulfathiazole) proved to be an important step as the data will show.

Another point may be important to mention. Some papers have appeared in the literature<sup>3,4,5,6</sup> which seem to show that urea counteracts the sulfonamide inhibitors. Since allantoin forms the basic paste for this combination of sulfonamides,

\*The ointment used in this experimental study is Allantomide with Sulfathiazole and is manufactured by the National Drug Company of Philadelphia.

it may be, at least partially, responsible for the destruction or blockage of the sulfonamide inhibitors through the urea which it contains. It is claimed that allantoin has the ability to exercise a chemical débriding effect on necrotic cells (such as are present in burn areas); it acts also to increase cell proliferation which stimulates healing.

Andrus, Nickel and Schmelkes<sup>7</sup> used hydrated films prepared from a hydrophilic cellulose derivative in which various chemotherapeutic agents were incorporated. Since these films are transparent, these workers could observe the healing processes of burns which were treated with 10 per cent sulfanilamide and buffer, with and without quantities of azochloramid. The longest time elapse required for complete healing was twenty-one days. These investigators treated burn wounds by débriding and cleansing with a solution of sodium chloride, boric acid, or azochloramid and sodium chloride as thoroughly as possible. Aseptic technic is followed closely. The preformed membrane is directly applied to the raw oozing surface of the burn. A dry sterile dressing is placed over the membrane and held by plain gauze bandage. New membranes are added when needed.

Hamilton<sup>8</sup> treated 199 burns with topical applications. He used Foille, tannic acid, sulfadiazine and cod-liver oil. He found no difference in their value as to saving life. He noted that superficial burns heal kindly whatever the local application, but Foille was superior to these other agents as a dressing for deeper burns in that it was more simple to apply; it reduced the healing time of third degree burns; it acted as a detergent for grease and oil, and it formed a soft, mildly antiseptic, easily changed coating, ideally suited to infected burns, to burns of the face, hands and genitalia and to the sloughing stage of third degree burns.

Weaver<sup>9</sup> stresses the point that successful treatment of burns is due to the careful preparation of the wound and the alert,

painstaking after-care, rather than the specific type of application. He believes that all burns should be considered infected when six or more hours have elapsed. Weaver advises the immediate thorough cleansing and débridement of burns, using white bar soap, large cotton swabs and an abundance of warm water, just as soon as the patient's condition will permit it. This seems to be in accordance with Allen and Koch's method. Weaver advises the use of a spray of triple dye; each coat is dried with a warm air dryer. The patient is then returned to bed between sterile sheet, under a warm cradle. Weaver advises against the use of coagulants in infected wounds.

Ravdin<sup>10</sup> states that the pressure dressing method has much to commend it. One of the sulfonamides, in the form of an ointment, can be placed on the burned area following débridement and the part firmly supported and bound. Plasma loss is decreased by this method, and the patient remains comfortable; further tissue injury is minimized and subsequent dressings are kept at a minimum. He advocates that a third degree burn be skin grafted as soon as possible, for this will reduce the incidence of infection, as such burned areas invariably become infected if not grafted.

Harkins<sup>11</sup> concludes that tanning is a reliable method for burns of the trunk and flat surfaces of the body while the use of sulfonamides, Bunyan envelopes and ointment-pressure dressings will be useful in many war burns. The primary treatment of any severely burned surface is incomplete until epithelial tissue has completely closed the burned area. The speed with which this is accomplished, as well as the comfort of the patient, and the attainment of a low mortality rate, are three important indices of the efficacy of any method of local treatment of burns.

Allen<sup>12</sup> has advocated the liberal use of soap and water followed by sterile vaseline gauze pressure dressings with early grafting. Koch used the same technic with

adequate results. Siler and Reid<sup>13</sup> confirmed this technic upon 137 patients who suffered a mortality rate of 3.7 per cent.

Clark and his associates<sup>14</sup> used penicillin in the form of a cream for the treatment of fifty-four burns and scalds with a view to the elimination of hemolytic streptococci. In forty-one of these wounds, (76 per cent) these organisms disappeared within five days and did not reappear. In seven instances the strains which promptly disappeared were insensitive to sulfonamide. Penicillin appeared to have a good effect in all cases and staphylococci, too, disappeared quickly from many of the wounds. Healing was rapid and no toxic effects were observed. Propamidine was also applied in the form of a cream (0.1 per cent) to thirty-four similar burns. Hemolytic streptococci disappeared within five days from twenty-one of the wounds (sixty-two per cent). In eight cases, however, they persisted during treatment with propamidine, and healing was rapid with this material. Coliform bacilli, when present in the wounds, were apparently not affected by either of these agents.

Meyer and Gradman<sup>15</sup> made a comparative study between sulfadiazine spray and non-adherent pressure dressing treatment of burns (Koch's method). They found that the spray may re-infect these wounds, healing may be incomplete, and second degree burns may be transformed to those of third degree. Besides, this method was more painful than the non-adherent pressure dressing. Koch's teaching is advocated, namely, convert all burns from contaminated wounds to clean wounds by aseptic and atraumatic cleansing with soap and water. Second, keep them closed and clean until healing occurs.

*Author's Method of Treating Burns.* The usual technics of treating shock are employed where necessary. As soon as possible, all burns are gently washed with very mild soap suds. This is followed by several rinses with sterile water. Débridement of necrotic tissue with the opening of blebs follows the bathing process.

Extreme care is taken to handle the burned areas in the most careful manner. The surgeon's hands should not touch the involved areas; sterile forceps are used to handle the gauze sponges during the washings.

If the patient is in near shock, or if actual shock is present, this is treated immediately before any manipulations are attempted.

After the wound has been cleansed thoroughly and carefully, and débridement has been carried out, the wound area is dried carefully with sterile towels. Care is taken not to rub the burned area. Gentle pressure with an ample number of towels will dry the area.

A sterile wooden tongue blade is used to apply the special ointment directly on the burn. A copious amount is employed. If it does not remain on the wound, another copious amount of the ointment is spread on a thick sterile gauze pad which is applied directly to the wound which is covered thoroughly along with the adjacent normal skin areas. Gentle, but firm, pressure with roller bandages, if practicable, is applied. This pressure serves two purposes: It causes a partial ischemia of the burn area which appears to aid in the healing process,<sup>1</sup> and the pressure helps to prevent the leakage of blood serum which, where allowed to escape in excessive amounts, may produce shock.

If the burn happens to be on an arm or leg, the bandaged arm or leg wound is splinted to assure rest which promotes more rapid healing, or if possible, the patient is kept at complete rest in bed for a week, at the end of which time the wound is redressed.

Many times the nursing staff and the patient will complain of the stench which is produced by the fermentation of protein products in the wound. This can be avoided by placing a waxpaper roll around the dressing and then an application of gauze is made which has been soaked in Dakin's solution.

During the time of the first dressing, the patient seems to be very comfortable.

Pain subsides usually with the application of the ointment. If a Curling's ulcer has not developed, the patient is given a gen-

area. The wound is then covered with the medication as has been described previously. It is not necessary, usually, to

TABLE I

Name, Age	Type of Injury	Complications	Length of Treatment	Results
S. C. (col.) Age—37	3rd degree burned hands	None	6½ wk.	Complete healing; no scars
J. C., Jr. Age—6 mo.	3rd degree burns both feet	None	7 wk.	Complete healing; no scars
E. W. Age—42	1st degree burn side of face	None	2 wk.	Complete healing; no scars
R. D. Age—58	2nd and 3rd degree burns neck and chest	Unknown—Patient insisted that dressings be changed daily. Patient very unco-operative and released for private care from service in City Hospital		Unknown
C. J. Age—60	3rd degree burns of hands and arms	None	7½ wk.	Complete healing; no scars
B. B. (col.) Age—27	Ulcer from iodine burn on leg	None	3 wk.	Complete healing; no scars
A. P. Age—41	Ulcer from gasoline burn on hand	None	4½ wk.	Complete healing; no scars
B. R. Age—29	2nd degree burn of hands	None	5 wk.	Complete healing; no scars
R. L. (col.) Age—33	2nd and 3rd degree burns of neck, back, both hands and arms	None	4½ wk.	Complete healing; no scars
H. M. Age—16	3rd degree burn of back	None	3½ wk.	Complete healing; no scars
J. W. Age—37	2nd and 3rd degree burns of hands, face and chest due to burning gasoline	None	4 wk.	Complete healing; no scars
B. G. Age—7	2nd degree burns of hands	None	2 wk.	Complete healing; no scars

eral diet which has been fortified with the addition of 8 oz. of fresh orange juice with each meal (vitamin C content).<sup>2</sup> If this is not practical, for one reason or another, 1 Gm. of ascorbic acid, in divided doses, is administered daily with the diet.

When the first dressing is changed, the injured area is soaked again very gently in soap suds for about fifteen minutes. This is followed by a rinse with sterile water which removes the remnants of the ointment which have adhered to the burned

wait a week for subsequent dressings. These may be changed within five days or so, and the same procedures are repeated until the wound has healed completely. (Table I.)

## SUMMARY

A modification of the Koch, Mason and Allen compression treatment of burns is described.

It is believed that this method is simple to administer. It gives the patient immedi-

ate comfort and therefore lessens pain and also shock. The pressure, produced by the compression bandaging, tends to prevent the formation of keloids.

Twelve patients with various degrees of burns have been treated with this method. Eleven patients have shown no signs of keloid formation and their healing was complete without the necessity of skin grafting.

One patient proved to be unco-operative and was released from our service. We do not know how he fared with regard to his injury.

The comfort of those patients who were under our care, was very evident since they were many times surrounded by other patients who were being treated by other attending men who used various other methods. After the first week all of our patients were well enough to become ambulatory while the other patients, not under our therapy, still remained in bed. Several of these have developed extensive keloids.

Since these findings are to be considered preliminary in nature, we do not advocate this method as a proved method. We describe these interesting findings with the hope that other surgical colleagues will try this procedure on their own series of cases and formulate their own opinions as to the efficacy of our modification for the treatment of burns.

#### REFERENCES

1. MARSHALL, W. and ROSENTHAL, S. Pathogenesis and experimental therapy of keloids. *Am. J. Surg.*, 62: 348, 1943.
2. MARSHALL, W. Physiological and bacteriological factors in wound healing. *West. J. Surg.*, 51: 24-27, 1943.
3. TSUCHIYA, H. M., TENENBERG, D. J., STRAKOSCH, E. A. and CLARK, Wm. G. Effect in vitro of urea-sulfathiazole combination on sulfathiazole resistant staphylococci. *Proc. Soc. Exper. Biol. & Med.*, 51: 245, 1942.
4. RANTZ, L. A. Failure of certain growth factors to inhibit sulfonamide bacteriostasis in simple media. *Proc. Soc. Exper. Biol. & Med.*, 49: 137, 1942.
5. TENENBERG, D. J., TSUCHIYA, H. M., CLARK, Wm. G. and STRAKOSCH, E. A. Effect in vitro of sulfonamides plus urea on escherichia coli in presence of p-aminobenzoic acid. *Proc. Soc. Exper. Biol. & Med.*, 51: 247, 1942.
6. DIMOND, N. A. p-aminobenzoic acid prevents the growth-inhibitory action of sulfanilamide. *Science*, 94: 420, 1941.
7. ANDRUS, W., DEW, NICKEL, W. F. and SCHMELKES, F. C. Treatment of burns with chemotherapeutic membranes. *Arch. Surg.*, 46: 1-8, 1943.
8. HAMILTON, J. E. A comparative study of local burn treatments. *Am. J. Surg.*, 58: 350, 1942.
9. WEAVER, D. D. Burn wounds: their treatment. *Calif. & West. Med.*, 57: 9-12, 1942.
10. RAVDIN, I. S. General consideration of the burn problem. *Clinics*, 1: 1-5, 1942.
11. HARKINS, H. N. *Ibid*, 6-23.
12. ALLEN, H. S. *J. A. M. A.*, 116: 1370, 1941.
13. SILER, V. E. and REID, M. R. Clinical and experimental studies with the Koch method of treatment of heat burns. *Ann. Surg.*, 115: 1106, 1942.
14. CLARK, A. M., COLEBROOK, L., GIBSON, T. and THOMSON, M. L. Penicillin and propamidine in burns. *Lancet*, May 15, 1943.
15. MEYER, K. A. and GRADMAN, R. Sulfadiazine treatment of burns. A comparative study. *Surg., Gynec. & Obst.*, 76: 584, 1943.



# COMBINATION OF NAIL AND SCREW FOR THE FIXATION OF FRACTURES OF THE NECK OF THE FEMUR

HERBERT A. JOHNSTON, M.D.  
On Surgical Staff, Anaheim Lutheran Hospital  
ANAHEIM, CALIFORNIA

THE writer started the operative treatment of hip fractures in 1919 by using bone transplants. Of the

more subject to the effects of shock. They are not satisfactory candidates for long periods of bed confinement and convalescence.

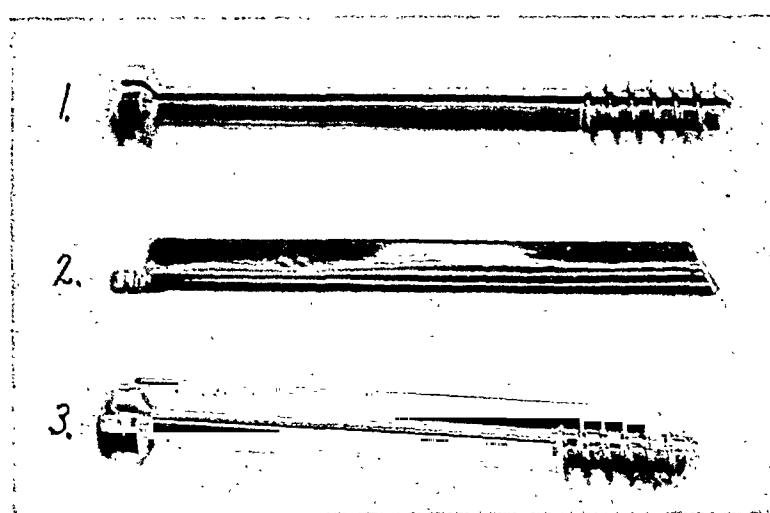


FIG. 1. The combined screw and nail (keyed screw): 1, The screw, threaded only at the end, showing slot from end to end to receive the key; 2, the key, which is to be driven in after the screw is inserted; 3, screw containing the key.

four patients operated upon, two had excellent results; in the other two the grafts were absorbed and broken before union took place. It is still probable that the bone graft might be used advantageously in association with some metal fixative in the subcapital fracture when it is believed that the circulation of the head has been materially decreased or entirely destroyed.

In fractures of the femoral neck certain mechanical requisites should not be overlooked. The great advantage to the patient in the use of the metal fixative which replaces so successfully the older traction and plaster of paris methods is apparent to anyone coming in contact with many of these cases. Most of the patients are in the later years of life and consequently are

more satisfactorily if they can turn over, sit up frequently, or be out of bed, as the case may be, which is possible if a metal pin has been used.

The operative procedure should be the most simple, of the shortest possible duration, and the least likely to be complicated by infection. With these things in mind we have devised a method which we think is the simplest and least shocking to the patient and perhaps one of the best methods of holding the fragments in position for healing. If a mechanic were asked to repair a table leg and he had only screws and nails at hand, we believe he would prefer the screws. The screw offers more security than the nail in holding parts together. Also no hammering is necessary. We have never observed any necrosis

around a screw and have used different metals. We have seen aseptic necrosis of the femoral neck in several cases but in no

down the shaft of the screw and necrosis occurs, the fragments, being held apart by the threads on the shaft of the screw, will

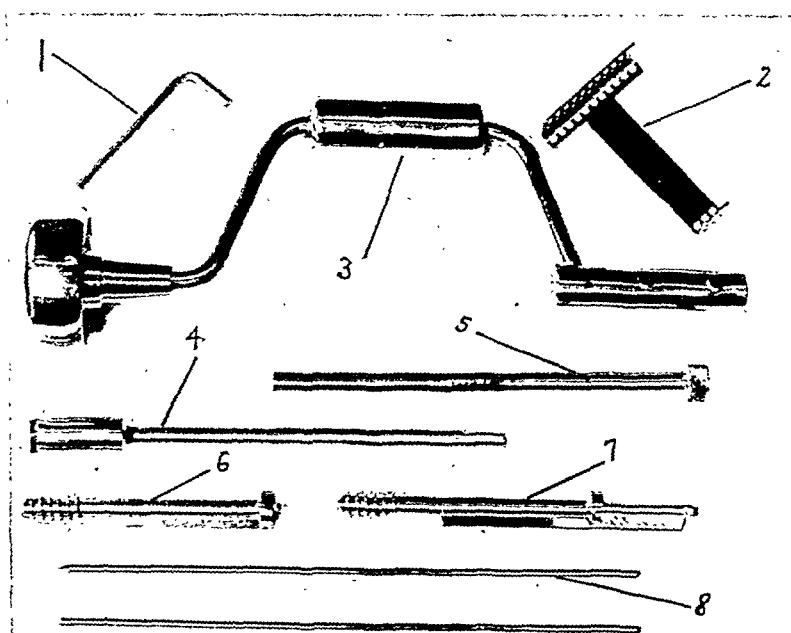


FIG. 2. Insertion set: 1, Allen wrench for brace; 2, director for guide-wire, if open operation is used, without leg-holder or fluoroscope; 3, brace for inserting guide-wire and screw-driver. Note shoulder on chuck for use of mallet if needed; 4, screw-driver specially made for insertion and extraction of screw; 5, key inserter; 6, screw with key in position; 7, screw with key inserted partially; 8, guide wires.

instance did it appear that the metal was a cause.

Because of the frequent occurrence of aseptic necrosis in the neck of the bone, we believe the screw should be firmly held in the head by deep threads. It should penetrate the head as far as possible even to engaging the cortex but, of course, it should not penetrate the joint. The threads on the screw are valuable only for their grasp of the head and they should not extend below the line of fracture. A screw constructed in this manner, with a smooth shaft, will not alter its position and will not work out as nails sometimes do, because they have nothing but friction to hold them in position. With this type of screw there is nothing to prevent constant apposition of the fracture surfaces should necrosis occur. If threads are continued

retain their apposition with great difficulty or not at all. A nail, or in fact any fixative that is not fixed to the head, may become loose and alter its position or even drop out. Also if it is fixed at the cortex of the shaft of the bone, it would be forced into the acetabulum or pelvis, should necrosis of the neck take place. Even the nail which is too tightly wedged into the cortex of the shaft of the bone may work gradually through the head and pelvis if necrosis occurs.

A screw, being round, does not prevent rotation of the head of the bone. To overcome this, two screws—sometimes parallel have been used. This, of course, requires twice as much work. To obviate the necessity of using two screws we devised the combination of nail and screw. The flanged nail has the advantage of preventing rota-

tion of the head. Our screw has a channel from end to end so that it readily follows a guide-wire. It also has a slot from end to

tion and also prevents rotation of the head. It may be inserted by any method of choice, large incision or small puncture.

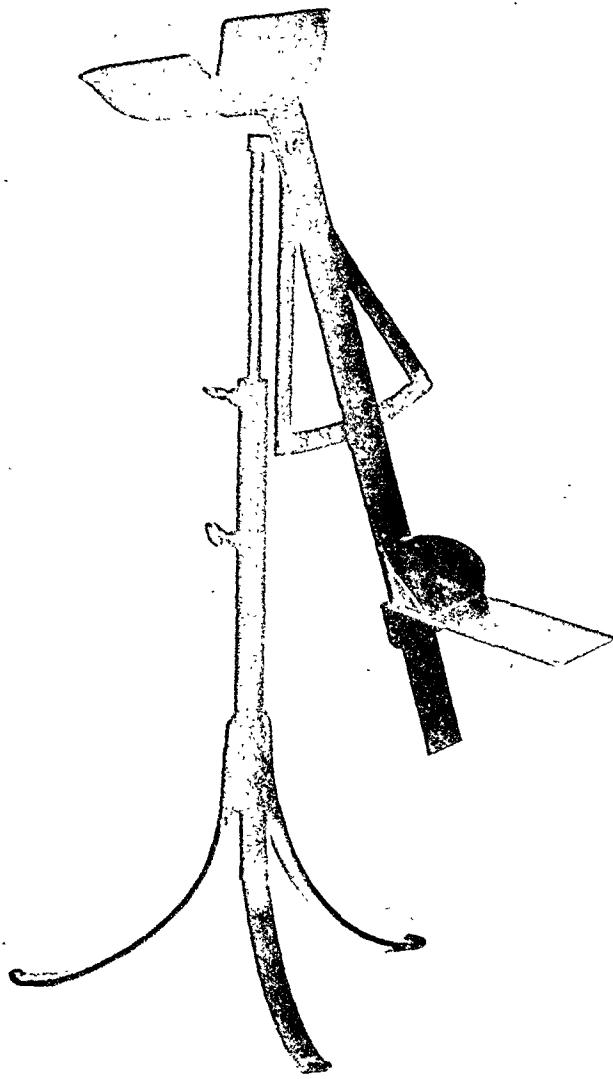


FIG. 3. The leg-holder consists of the standard; the holder for thigh at knee and the movable foot-holder; it is adjustable to either leg. A scale is marked from 0 to 35 degrees of a quadrant for abducting the leg and holding it at a specified angle during the operation.

end for the reception of a key which is the same length as the screw and is very easily inserted. The key is thicker on the inner border and is made to fit the guide-wire channel. It is flat and when inserted projects through the slot from end to end of the screw. It is driven in after the screw is inserted. The screw provides compression of the fragments and the key becomes a flange which prevents its change of posi-

To determine the length of screw required, measure the distance from the outer cortex of the shaft to the outer cortex of the head, using the roentgenogram of the opposite hip, or of the affected one after reduction. A screw four-fifths of that length will not perforate the joint but may be an eighth to a quarter of an inch too short. Should the screw be too long or too short it is very easily removed so

that one of the desired length may be substituted. The inner end of the screw should incorporate as much of the head as possible,

of the fluoroscope in the operative fixation of hip fractures. We have used it so many times that we would consider hip-nailing



FIG. 4. The patient is on the x-ray table with leg abducted, after reduction, and ready for placing of pencil lines on the skin by use of the fluoroscope and heavy wire.

especially in the subcapital type of fracture. One is indeed fortunate when the fixative penetrates so deeply that it almost enters the joint, because the center of the head is softer than the cortex and not as capable of firmly holding the screw when it has to combat the sheering forces of the muscles.

Something should be said also about the advantages to be obtained from the use

difficult without its aid. One must have capable, co-operative assistants to accomplish satisfactory results. The average x-ray table is suitable. Sufficient space must be available in the room for the sterile team to function safely. The patient is given a spinal anesthetic. We use 50 mg. of novocain and 1 cc. of nupercain solution. The fracture is reduced by the Leadbetter procedure, and the affected hip is placed

in the center of the table (laterally). The leg and foot are brought over the side of the table at a right angle with the thigh,

against the trochanter and iliac crest. If the lateral roentgenogram is satisfactory, the trochanter, neck, and head, will be



FIG. 5. Screw being inserted over guide-wire and visualized on fluoroscope. The fluoroscope is covered underneath by sterile towels. Note the pencil lines on skin, and that the screw has entered at the point where the lines cross.

and then placed in a leg-holder which holds the leg at 18 degrees abduction. This in turn rotates the head, neck, and trochanter into a horizontal plane, the value of which will be discussed later. The fluoroscope will demonstrate the postero-anterior projection of the fracture (since the undertable tube is being used) and if it is satisfactory, a lateral roentgenogram should then be taken, which will be accomplished best by using a portable x-ray machine directed under the elevated and vertically flexed opposite thigh, the cassette being held

superimposed upon it. Should the trochanter require shifting to place it directly in line with the head, note that five degrees' movement of the foot and leg in the leg-holder will shift the trochanter about  $\frac{1}{2}$  cm. either way; but we have found that placing it at 18 degrees is correct in most instances.

Reduction and position being found satisfactory, the room is darkened and the fluoroscope is again lowered to the level of the patient. The roentgenologist or technician visualizes the head, neck and tro-

chanter on the screen, closing the shutter to a beam as narrow as possible. A heavy wire about ten inches long is placed on the patient and under the screen, and directed

guide-wire and later the screw and key. The heavy wire, being of no further use, is removed from the field and must not be confused with the guide-wire.

FIG. 6.



FIG. 7.



FIG. 6. Lateral view of fracture of the neck. The guide-wire has been inserted, having been held horizontally, with leg in holder at 18 degrees abduction at time of insertion.

FIG. 7. Lateral view of keyed screw inserted over a guide-wire.

by the use of the fluoroscope to a position in line with that to which the guide wire and screw will be inserted later. The lights are now turned on. After ascertaining that the wire has not moved out of place, draw a line with a skin pencil from it vertically down the outer side of the thigh, and cross this line at right angles with another pencil line, drawn on the skin, directly lateral to the center of the femoral shaft, bisecting it horizontally. The point where these lines cross indicates where the puncture should be made in the skin to admit the

The surgeon scrubs and the nurses prepare the patient in the usual way for a major surgical procedure. The screen is covered on its undersurface with a sterile towel attached by adhesive strips to its edges, leaving the upper surface uncovered. The usual draping and sterile operating room methods supervene. A three-fourths inch incision parallel with the long axis of the thigh is made in the skin through the point where the pencil lines bisect and horizontal to the center of the shaft of the femur. The scalpel is pushed to the

bone in the horizontal direction and the tissues are spread apart with a hemostat. The guide-wire is inserted through the incision, the room is darkened, and with

and held against the wire and the iliac crest by the sterile nurse while being exposed to the portable x-ray machine as already described. If the roentgenogram



FIG. 8. Anteroposterior view of keyed screw in a case in which fracture occurred close to the trochanter. It is unnecessary for the screw to be sunk as deeply into the head as in subcapital fractures.

the aid of the fluoroscope the wire is correctly placed against the center of the cortex and at the desired angle to enter the neck and head. The operator holds the wire in a horizontal position. He inserts it slowly, being directed by the fluoroscope. He sees it pass through the cortex and along the neck to the head. Rarely is a wire found to be in faulty position on its first insertion if it is held horizontally. The lights are now turned on. Only a lateral roentgenogram is needed for confirmation. It is taken in the following manner: The cassette is placed in a sterile pillow slip

is satisfactory, the screw and driver are now assembled and the screw is placed on the guide-wire and driven into place by a special screwdriver, which is hollow and follows the screw over the wire. Near the completion of this step, the lights are turned out and the fluoroscope is used to see that the length of the screw is right, and that it is turned tightly but not too tightly, preserving the grip on the threads in the head. The lights are turned on again. The key is inserted into the slot and tapped gently into position. At no time during the operation does the gloved

hand touch any part of the guide-wire, screw, key, or wound. Two silk skin sutures complete the operation.

We have performed fifty-four of these

decrease in the number of roentgenograms necessary and the shortening of the time required to perform the operation are worth considering.



FIG. 9. Subcapital fracture with extensive absorption of the neck. The screw was sunk as deeply as possible into the head. Note how the head of the screw projects beyond the shaft, without much probability of a change of position or loss of grip on the head, while still holding the fracture surfaces in fair position nine months after insertion.

puncture operations for the fixation of hip fractures. We are finding this method more and more simple and eminently suitable for the aged because of the slight injury to the patient.

We believe the x-rays are not dangerous to anyone in using this method, as the periods of use are very brief and the operator's hands are well out of the field of danger.

While some fear that sterilization of the field is less certain because of doing the work in an x-ray room, we have not found that to be the case. We believe that a well trained team can work just as safely and successfully in an x-ray room as in an operating room, especially if the small skin-puncture method is used. The great

#### SUMMARY

1. A screw, consisting of a combination of screw and nail, for the fixation of hip fractures, is described.
2. A leg-holder, which maintains a constant position of the head, neck, and trochanter during operation, and is capable of rotating them to a horizontal plane, simplifies the insertion of any fixative, whether it be nail, bolt or screw.
3. A method of inserting a screw through a small skin puncture, obviating the need for an extensive incision, is described.
4. A method of using the fluoroscope so that a guide-wire, nail or screw, may be inserted under full vision, without risk to the operator, is shown.



# PARENTERAL FLUID ADMINISTRATION BENEATH THE FASCIA LATA\*

ROBERT KENT FINLEY, M.D.,  
On Surgical Service, Miami Valley Hospital  
DAYTON, OHIO

JAMES MILO SHAFFER, M.D.  
On Surgical Service, Miami Valley Hospital  
DAYTON, OHIO

AND  
ALFONS ALTENBERG, M.D.  
MEMPHIS, TENNESSEE

THE importance of meeting adequate fluid and electrolyte requirements in the sick surgical patient cannot be stressed too strongly. A marked decrease in morbidity and mortality has been evident in those patients whose requirements are competently and carefully supplied day by day. This replacement of fluids assumes its greatest consequence in the patient unable to take fluids by mouth.

The giving of fluids and electrolytes by parenteral means has been employed for many years. Originally, they were given for the most part by proctoclysis. However, this method has fallen into disrepute to some extent in late years for several reasons. Among these may be mentioned first, technical difficulties in administration; second, inability of many patients to retain fluids rectally; third, variations in absorption among different patients; and fourth, doubtful accuracy as to the exact fluid intake. Thus, the utilization by the surgeon of more precise methods, such as intravenous and subcutaneous infusions, has largely supplanted rectal fluid administration.

Recently, Tocantins<sup>1</sup> has described a method of infusion into the sternal bone marrow and has devised a needle for administration. This shows great promise as an adjunct in regulating parenteral fluid intake.

Infusions by the intravenous and subcutaneous routes, however, are still the methods of choice of most surgeons at the

present time. Unquestionably, hypertonic solutions and whole blood, where indicated, should be given by the intravenous route. However, there is a widespread difference of opinion as to the relative merits of hypodermoclyses and of intravenous infusions in giving isotonic or near isotonic fluids.

Probably the greatest source of dispute between the adherents of the two methods rests on the safety factor of the hypodermoclysis as compared to the ease of administration and lack of pain of the venoclysis. That there is definite harm in indiscriminate use of intravenous infusions cannot be denied. Orr<sup>2</sup> summarizes these dangers as, first, immediate reactions; second, overburdening of the circulatory system by rapid increase in blood volume; third, thrombosis and concomitant embolus formation at the site of injection; fourth, the danger of dehydration because of the use of hypertonic solutions; and fifth, the production of general edema. He has discontinued the use of continuous intravenous infusions because of the danger of local venous thrombosis and embolism and reports one fatality following excessive quantity of fluid by vein to an anemic patient with damaged heart muscle.

Clark<sup>3</sup> stresses the dangers of acute cardiac dilatation. Hirshfeld, Hyman and Wanger<sup>4</sup> call attention to the possibility of so-called "speed shock" when venoclysis is given too rapidly. Further dangers and fatalities have been reported by Orator

\* This work was done on the Surgical Service of Dr. R. K. Finley at the Miami Valley Hospital, Dayton, Ohio.

and Schleusing,<sup>5</sup> Tomarkind and Strauss,<sup>6</sup> Rumold,<sup>7</sup> Friedrich and Buchaly,<sup>8</sup> and Cutting, Landis and Larson.<sup>9</sup>

On the other hand, many objections have been raised to the administration of subcutaneous infusions. It is generally admitted that this method is more physiological, in that the fluid given is absorbed by the circulation as needed rather than introduced indiscriminately at varying rates of speed, usually left up to the discretion of the nurse. However, the disadvantages of the clysis usually enumerated are first, severe pain and discomfort at the site of injection; second, immobilization of a postoperative patient for several hours at a time when frequent turning is greatly desired; third, local pressure ischemia at the site of injection due to swelling and distention; fourth, frequent slow absorption; and fifth, the danger of infection in the subcutaneous tissues. Morrison<sup>10</sup> points out the danger of cyanosis and decreased vital capacity in subpectoral clysis, while Orr<sup>11</sup> and Tenopyr and Shapiroff<sup>12</sup> mention the possibility of gas bacillus infection.

#### SUB FASCIA LATA HYPODERMOCLYSIS

In an effort to obviate the disadvantages of hypodermoclysis and still make use of the many desirable factors this method offers, we began the study of various methods of subcutaneous fluid administration. It was soon obvious that regardless of the site, whether on the chest, abdomen, back or thighs, the introduction of fluids immediately under the skin caused a rather violent disruption of the subcutaneous tissue. The result was that unless the patient was decidedly dehydrated, only about 50 to 100 cc. of fluid could be delivered per hour without marked discomfort.

It has been shown (Van Hook<sup>13</sup>) that there is no pain experienced in giving subcutaneous infusions if the fluid is not given at a speed greater than the ability of the tissue to absorb it. Furthermore, it is obvious that the greater the absorption

area, the faster a solution will be absorbed. It occurred to us that there was a large potential space for absorption immediately beneath the broad layer of fascia on the lateral aspects of the thigh. This fascial band, the fascia lata, dissects easily from the underlying muscles, as is often demonstrated surgically when fascial transplants are taken. The fascia lata has extensive attachments above to the pubic bones, inguinal ligament, iliac crest, sacrum and coccyx and below to all the prominent points around the knee joint. Taking all these factors into consideration, we felt justified in giving sub fascia lata hypodermoclysis a careful trial. The results were gratifying.

We have been unable to find any description of this exact method in the literature, and believe that it merits preëminent consideration when parenteral isotonic or near isotonic solutions are required. The technic is simple. After the skin on the lateral aspect of the thigh is prepared with a good skin antiseptic, the standard eighteen gauge hypodermoclysis needle is inserted at about a forty-five degree angle to the skin. The point of preference is at the junction of the lower and middle third, lateral surface, and equidistant between the anterior and posterior aspects of the thigh. The needle is inserted to the fascia lata, where a sensation of "give" is felt as the point passes through the fascia. The point is allowed to remain at this depth although it may have to be altered slightly until the best rate of flow of the solution is obtained. The solution is suspended approximately three feet above the legs and allowed to run as rapidly as possible. Only rarely is it necessary to check the rate of flow. The needles are not taped to the skin, since they are held in place quite firmly by the fascia. There is no danger of breakage of the needle, if it is not taped, since the fascia acts as the only fixed point and the needle is permitted to swing slightly if necessary. A pillow beneath the knees relaxes the fascia and facilitates insertion of the needles. In unconscious patients,

the knees are lightly tied together with gauze bandage.

#### ANALYSIS OF RESULTS OBTAINED IN SUB FASCIA LATA CLYSIS

Careful studies were carried out on 261 consecutive sub fascia lata hypodermoclyses started in every instance by one of us. A complete analysis was not carried out on approximately 500 additional cases started by nurses taught this method, although the results closely checked with those started by us. Sixty three of these 261 cases were of physiological saline solution and 198 were of 5 per cent dextrose in saline solution. For uniformity, every clysis given consisted of one liter (1,000 cc.) of fluid. The total number of patients receiving these hypodermoclyses was 112, many patients receiving several clyses. The greatest number given to any one patient was nineteen. This patient, operated upon for ruptured peptic ulcer, suffered from severe myocardial damage, and fluids given intravenously were restricted to blood transfusions.

TABLE I  
AVERAGE TIME FOR COMPLETE ABSORPTION OF 1,000 CC.  
OF FLUID GIVEN BENEATH THE FASCIA LATA IN  
261 CASES

	Cases	Absorbtion in Minutes
Physiological saline.....	63	53
Five per cent dextrose in saline..	198	57
Combined.....	261	56

The average length of time for complete absorption of 1,000 cc. of both types of fluid was fifty-six minutes. The saline solution was absorbed at a slightly more rapid rate of speed than was the dextrose, the average being fifty-three minutes as compared to fifty-seven minutes for 5 per cent dextrose, which is slightly hypertonic. (Table I.) It took less than twenty minutes for absorption in thirteen cases (5 per cent), between twenty and forty minutes for seventy-four cases (28 per cent), and between forty and sixty minutes for

116 cases (44 per cent), making a total of 203 cases (77 per cent) absorbed in less than one hour. Only thirty four cases (13 per cent) took longer than eighty minutes while twenty-four (9 per cent) took between sixty and eighty minutes. (Table II.)

TABLE II  
TIME TAKEN FOR ABSORPTION OF 1,000 CC. OF FLUID  
GIVEN BENEATH THE FASCIA LATA IN 261 CONSECUTIVE  
CASES\*

Time Consumed in Minutes	Cases	Per Cent
0- 20	13	5
20- 40	74	28
40- 60	116	44
60- 80	24	9
80-100	13	5
Over 100	21	8
Total.....	261	99

\* Note that 203 cases (77 per cent) were absorbed in less than one hour, while 240 cases (92 per cent) took less than 100 minutes.

For comparison, the time for absorption of 1,000 cc. of fluid by hypodermoclysis given on the medial aspect of the thigh was computed. In thirty-three consecutive cases, the average length of time was 167 minutes.

TABLE III  
AVERAGE RATE OF ABSORPTION FOR SUB FASCIA INFUSION,  
AS RELATED TO AGE OF PATIENT. THE BEST RESULTS  
WERE OBTAINED OVER THE AGE OF FIFTY,  
PROBABLY DUE TO GREATER RELAXATION  
OF THE FASCIA

Age in Years	Absorption in Minutes
0-30.....	59
30-50.....	65
50-70.....	57
Over 70.....	41

Upon dividing the patients into age groups, it was soon evident that the older the patient, the more quickly the fluid was absorbed. (Table III.) The average length of time for absorption in patients above the age of seventy was only forty-one minutes as contrasted to an average time interval of sixty-five minutes between the ages of thirty to fifty. That this is

MARCH, 1944

not entirely due to greater dehydration in the older group was clearly shown when all cases were compared on the basis of the urinary output during the previous twenty-four hours. While urinary output should not be used alone as a basis for hydration since it does not take into consideration factors such as fever and increased metabolism, yet it does provide a simple, fairly accurate gauge for comparative studies in a large series of cases.

Using urinary output as a rough control for the state of hydration, it was found that in those cases in which the urinary output was below 500 cc. in the previous twenty-four hours, the rate of absorption was forty-one minutes. However, in those patients with an output of between 1,000 and 1,500 cc., the rate of absorption was only slightly increased, averaging forty-five minutes. The average time for absorption was longest in the group whose urinary output varied between 500 to 1,000 cc.

In comparing the time for absorption as related to the state of hydration, in patients of various age groups, it was found that in the patients above the age of seventy, whose rate of absorption was only forty-one minutes (Table III) the average urinary output was 1,023 cc. during the previous twenty-four hours. Thus the difference in absorption which was evident in the various age groups is due to some factor other than dehydration, and most probably due to greater relaxation of the fascial structures in the older patients with concomitant increased area for absorption.

No significant differences in absorption rates were seen according to sex or to weight.

While it is true that there is a great variation in the pain threshold in different patients, yet the pain experienced was evaluated as accurately as possible, since pain has always been a major objection to administering subcutaneous infusions. A total of only forty-four patients (16 per cent) experienced pain in any degree. Of these, thirty-seven are graded as

moderate or mild in character while only seven complained of severe pain. As was expected, fewer patients (12 per cent) complained of pain following saline infusions than following 5 per cent dextrose infusions (19 per cent). Many of the patients suffered discomfort in only one leg. (Table IV.)

TABLE IV  
PAIN AND SWELLING OBSERVED IN 261 CASES OF SUB FASCIA LATA INFUSION. MANY PATIENTS COMPLAINED OF DISCOMFORT IN ONLY ONE LEG

	Mild	Moderate	Severe	Total Cases	Per Cent
Pain.....	20	17	7	44	16
Distention.....	36	20	2	58	22

There appeared to be a slight but definite relationship between pain and speed of absorption. The average time consumed in absorption of the infusions causing pain or discomfort was sixty-two minutes for the glucose group and fifty-five minutes for the saline group, in both cases above the average for the group as a whole.

Swelling of one or both legs, so commonly seen in the ordinary hypodermoclysis, was observed in only fifty-eight patients (22 per cent). The swelling again was more commonly found when dextrose was given. In grading swelling as mild, moderate or severe, it was found that thirty-six patients had only very slight swelling, twenty had moderate swelling, while in only two cases was marked swelling noted. (Table IV.)

As might be expected, there was a definite relationship between pain and swelling. Thus of the forty-four patients complaining of pain, thirty-four also suffered from visible distention of the tissues.

There was only one complication observed. This patient developed an extensive infection on the lateral aspect of the leg. He had received approximately twenty hypodermoclyses, many of which were started subcutaneously by the nurses. Abscesses developed along the leg but at

operation these were found to be confined entirely to the subcutaneous tissue superficial to the fascia. This infection was evidently introduced into the subcutaneous tissue and found a ready bed in the ischemic tissue present secondary to the marked swelling so often seen in the ordinary type of hypodermoclysis.

#### COMMENT

While it was believed that the fluid introduced beneath the fascia was absorbed rapidly and did not pool beneath the fascial sheath, since there was so little evidence of swelling, nevertheless comparative studies were made on the rate of absorption between intravenous and sub fascial infusions. These were conducted by giving 1,000 cc. of 5 per cent dextrose in physiological saline, to which had been added 1 cc. of phenolsulphonphthalein dye, both intravenously and by sub fascia lata infusion to the same patient on different days. The tests were conducted both on patients in good health and on patients with known kidney damage. Usually the tests were run on the tenth to twelfth postoperative day with the patient in condition to be discharged from the hospital, and care was taken that the state of hydration was essentially equal on the days the tests were conducted. The rate of flow was adjusted so that both types of infusions were delivered in one hour. A retention catheter was inserted and the bladder drained at the termination of the administration of fluid. The bladder was irrigated in order to be certain that all the dye excreted would be obtained. Specimens were collected at six one-half hour periods.

It is valid to assume that the amount of dye returned in the urine is representative of a proportional amount of fluid absorbed from beneath the fascia, since in a patient in good fluid balance, the urinary excretion will be approximately the same from day to day under similar conditions. Since the dye is removed from the blood stream at a constant speed by the kidneys, it follows

that the rate of absorption is the only remaining variable. In this manner, the rate of absorption of a sub fascia lata

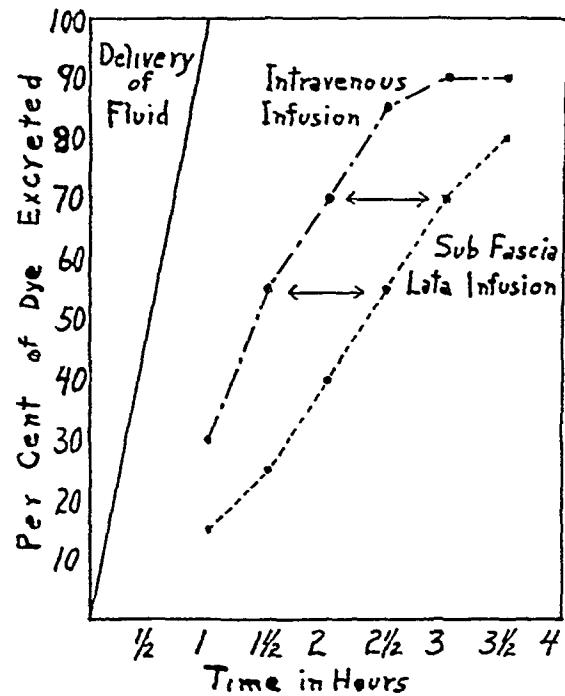


FIG. 1. Excretion of phenolsulfonphthalein dye in the urine following infusions of 1,000 cc. of saline containing the dye by intravenous and subfascia route. Each infusion was delivered in one hour to the same healthy, well hydrated patient on consecutive days. Note that the absorption is at a constant rate with a lag of approximately one hour when given beneath the fascia as compared to the intravenous route. This represents practically immediate absorption from the subfascia space.

infusion can be estimated by comparing the phenolsulfonphthalein excretion with that of an intravenous infusion which may be considered to have immediate absorption.

On comparing the rate of excretion of the dye, it was found that there was only a difference of excretion in the two types of infusions of about one hour. (Fig. 1.) This difference proved to be consistent in those patients with myocardial and kidney damage as well as those with good renal function and cardiac reserve. Since the sub fascial infusions were adjusted to deliver the solution to the patient in just one hour, which was the same time taken for delivery of the intravenous fluid, it

appears evident that there must be almost immediate absorption of the fluid.

There are undoubtedly certain patients who should never receive sub fascial infusions, such as those with generalized edema or patients in shock. In general, the same contraindications exist to giving fluid beneath the fascia lata as beneath the skin. In infants, a 3 per cent solution of dextrose should be given rather than the 5 per cent. We have given as high as 200 cc. beneath the fascia in a six-week old dehydrated infant, weighing less than seven pounds, in forty-five minutes, without visible swelling or noticeable subjective evidence of discomfort.

While the investigative work on sub fascia infusion has been done with physiological saline and 5 per cent dextrose in saline, there appears to be no reason why other solutions cannot be delivered to a patient by this method. Cooper<sup>14</sup> has shown, in one patient suffering from cirrhosis of the liver, that ascitic fluid is absorbed rapidly from beneath the fascia. This absorption of ascitic fluid, rich in proteins, maintained the blood chemistry as shown by repeated blood albumin and globulin determinations, and also maintained the improved clinical condition of the same patient as demonstrated by lack of ankle edema.

Attention should be called to several additional factors in the administration of sub fascia lata hypodermoclysis. After learning the technic, these infusions can be left entirely in the hands of the nurse. Also, since there is no necessity for constant supervision, because of the diminished pain and distention as compared to ordinary hypodermoclysis, there is a definite saving of nursing time and care.

The sub fascia lata infusion is far safer than the ordinary type of hypodermoclysis. There are no large vessels on the lateral aspect of the leg, no embarrassment to respiration or danger to axillary vessels as is true with hypodermoclysis on the chest, and no danger of inadvertently introducing the solution into the knee

joint. There is also less danger of secondary contamination in the incontinent patient. The patient, in addition, can ordinarily be turned from side to side within an hour after the infusion has been started, thus eliminating long periods of immobilization and subsequent increased hazards of pulmonary complications. There is no danger of breaking a needle if the needles are not taped to the skin.

Finally, because of the minimal amount of discomfort and swelling, there is no need to give more than one liter at a time. The infusion may be repeated several times daily if necessary to maintain proper fluid and electrolyte balance, with perfect safety and minimal discomfort, thus decreasing the potential and real dangers of repeated intravenous infusions. Intravenous fluid may be restricted to hypertonic solutions or blood transfusions when indicated.

#### CONCLUSION

An improved method of administration of parenteral fluids beneath the fascia lata has been described. In 261 consecutive sub fascial infusions of 1,000 c.c. of saline or 5 per cent dextrose by this method, the average time for delivery of the solution was fifty-six minutes. In thirty-three patients the average time for absorption of the same amount of fluid by hypodermoclysis was 167 minutes. The solution appears to be absorbed rapidly, as shown by excretion of phenolsulfonphthalein dye in the urine. This absorption probably takes place in the extensive loose areolar space and capillary and lymphatic bed just beneath the fascia lata. There is more rapid absorption in elderly patients, probably because of more lax structures. The rate of absorption is not greatly influenced by the state of dehydration.

There is minimal swelling and pain in sub fascia lata infusion. Because of the decreased discomfort, increased rate of absorption, and unquestionable safety of the method, fluid and electrolyte needs can be replenished several times daily

in this way and intravenous solutions restricted, for the most part, to transfusions and hypertonic fluids. The sick surgical patient may be moved in bed frequently, without long periods of immobilization. Finally, the technic of insertion on the lateral thigh is simple and because of the rapidity of absorption, the entire procedure can be left safely in the hands of the nursing staff with elimination of a large amount of nursing time and care.

## REFERENCES

1. TOCANTINS, L. M. Rapid absorption of substances injected into the bone marrow. *Proc. Soc. Exper. Biol. & Med.*, 45: 292, 1940.
2. ORR, THOMAS G. The use and abuse of intravenous therapy in surgery. *J. Missouri M. S.*, 34: 219, 1937.
3. CLARK, J. H. Acute cardiac dilatation; an ever present danger in intravenous injections. *J. A. M. A.*, 89: 21, 1927.
4. HIRSHFELD, S., HYMAN, H. T., and WANGER, J. J. Influence of velocity on the response to intravenous injections. *Arch. Int. Med.*, 47: 259, 1931.
5. ORATOR, V. and SCHLEUSING, H. Thrombose und Hirnembolie infolge intravenöser Dauertropfinfusion. *Zentralbl. f. Chir.*, 57: 2530, 1930.
6. TOMARKIND, J. and STRAUSS, A. Venoclysis: dangers and contraindications. *Am. J. Surg.*, 25: 319, 1934.
7. RUMOLD, M. J. Experimental pulmonary embolism associated with venoclysis. *Arch. Surg.*, 30: 685, 1935.
8. FRIEDRICH, H. and BUCHALY, J. F. Ist die intravenöse Dauertropfinfusion mit Gefahren verbunden? *Zentralbl. f. Chir.*, 59: 131, 1932.
9. CUTTING, R. A., LANDS, A. M. and LARSON, P. S. Distribution and excretion of water and chlorides after massive saline infusions; experimental study. *Arch. Surg.*, 36: 586, 1938.
10. MORRISON, JOHN. Study of postoperative hypodermoclysis. *Anesth. & Analg.*, 8: 75, 1929.
11. ORR, T. G. Gas bacillus infection following subcutaneous injection of salt solution. *J. Kansas M. Soc.*, 35: 213, 1934.
12. TENOPYR, J. and SHAPIROFF, B. J. P. Gas infection after hypodermoclysis. *J. A. M. A.*, 106: 779, 1936.
13. VAN HOOK, WELLER. Introducing solutions subcutaneously. *Boston M. & S. J.*, 195: 219, 1926.
14. COOPER, J. R. Personal communication.



# PERINEORRHAPHY POSTPARTUM VERSUS PERINEAL REPAIR

## ORIGINAL TECHNIC

LOUIS DROGIN, M.D.

Attending Gynecologist and Obstetrician, Beth David Hospital

NEW YORK, NEW YORK

A PREPONDERANT majority of women sustain an assault on their perineum and anterior vaginal wall during the delivery of a child; but the severest assault they sustain during the first full term or near term delivery. Tears are as a rule visible; but the invisible ones are just as fraught with serious consequences as the frankly visible ones. The postanococcygeal, the anopostanal, the anal, the anoperineal and perineovaginal sections of the pelvic floor are stretched consecutively during the end of the first stage of labor and the beginning of the second stage, to a point where the tissues snap in the most vulnerable portion; and that is, as a rule, the perineovaginal or vaginal portion. This causes the visible tears. The first sign of such occurrence is bleeding from the vagina when the head is bulging the perineum. An examination of the vagina between pains will show a mucous or submucous tear. This bleeding is often referred to as the show, but this is of a different nature than the show seen at the onset of labor. We have then to distinguish between uterine show and vaginal show.

The most dependent portion of the pelvic floor is the anal region, but this is sufficiently dilatable to preclude a tear here at this stage of labor; and this dilatability is in direct relation to the mobility of the coccyx. The most vulnerable part is the perineovaginal. Owing to the influence of the anal dilatability and its own moderate resilience it will often not sustain a frank tear or, depending upon other circumstances, will escape a

tear completely. Dr. Herbert M. Little<sup>1</sup> mentions "the possibility of subcutaneous rupture of the muscles" of the perineum. The fascia in invisible tears is torn, attenuated or separated from its attachment or all these injuries combined may be present; and the angle or ellipsoid formed by the levators at this lower point is now deepened and widened or rounded; thus permitting, subsequently, a rectocele formation. Such blind tears as well as the frank ones, if uncorrected or insufficiently corrected, will, in addition to forming a rectocele predispose to cystocele development, and depending upon the extent of the injury, will also pave the way for a prolapsus uteri. Retroversion or retroflexion, independent of prolapsus, is as a rule an antecedent condition. The relaxed and sagging state of the vagina or the absence of tonicity of the same, will not only prevent a cervical tear from healing by first intention but will permit eversion of the lips with all the baneful effects. The blind tears are always left alone. A mucous tear is sometimes united and if the sutures are inserted deeply enough will mitigate the injury.

Frank tears are as a rule repaired. Episiotomies are always repaired. I employ the word "repaired" advisedly because that is just what should not be done. A perineorrhaphy is indicated.

Repairs of the perineum are usually done when the obstetrician believes that he is doing a perineorrhaphy, and this because he inserts the sutures deeply, intending to include the levators, when he is only embracing the tumified and broken fascia and more or less of the anterior edge or

aspect of the levators. As a matter of fact the levators, in reaction to the push and tension exerted on them by the head and

the union of the levator with the pubes; externally by the pubic ramus; the lower boundary is formed at the point of branch-

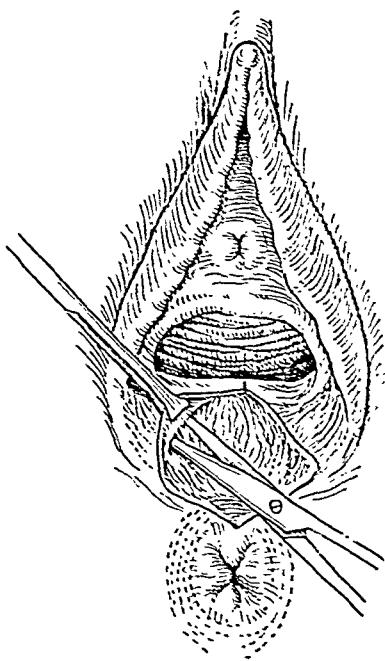


FIG. 1. Grabbing edge of mucous membrane and undermining it with blunt pointed scissors in an advancing opening and closing manner. In order to prevent the mucosa from tearing, the points of pressure of the scissors are gently directed toward the fascia. This maneuver is continued until the levators are exposed in depth and in height. The short longitudinal line in the center of the upper edge of the tear is intended to suggest its enlargement after undermining the mucous membrane and cutting it in the midline to facilitate the separation of upper ends of the levators. Occasionally, we encounter a mucous membrane that is friable. Regardless of such friability, the object is to expose and unite the levators; nature takes care of the breaks or missing parts of such mucosa.

shoulders will, on release of such pressure, suddenly recede one-fourth inch or more from their normal position; or they will be pushed forward and laterally into the blind semi-circular concavities; they can be normally outlined with the tip of the finger. (The delimitations of these concavities are, anteriorly, the hymen or its base and posteriorly, the anterior edge of the levator ani; above the angle formed by

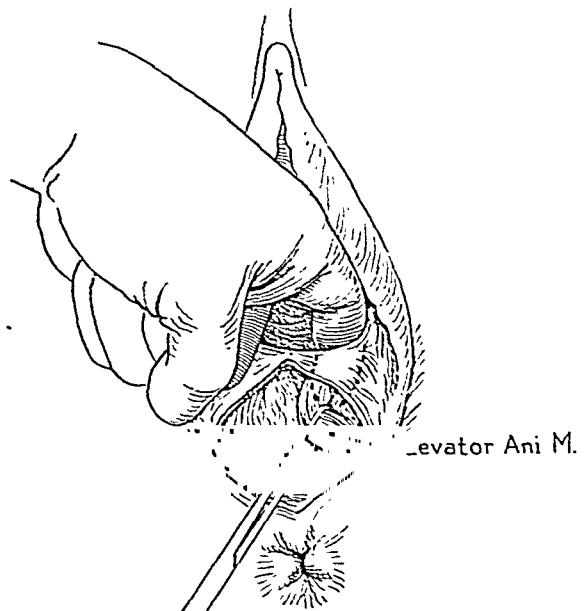


FIG. 2. The complete depth of the left levator ani muscle caught within the grasp of the tenaculum forceps with the aid of the finger pushing the levator forward. The same thing is done to the right levator.

ing of the levator surrounding the anal sphincters; internally it is bounded by the loose vaginal mucosa.) When both levators are forced into these blind pouches, the inflated rectum usually fills the space between them. These reactions are implemented by the extent of the tear. With a "repair," the widened or squared or semi-circumfered lower angle of the levators remains, usually, sufficiently ample to permit the formation of a rectocele. A cystocele or prolapse or relaxation of the anterior vaginal wall of some degree invariably follows unless it is supported by a high perineorrhaphy. If injury is slight, "repair" is often sufficient; but the tear may be both, partly visible and partly invisible and the extent of the injury is then an unknown quantity.

The difficulties of doing a perineorrhaphy are almost insurmountable in a delivery room equipped for deliveries and at best for perineal repairs. In an operating room, in doing a perineorrhaphy, we have the assistance of two interns, a scrub nurse

and a circulating nurse. In a delivery room we get, as a rule, one assistant or a scrub nurse or neither. Under the latter condition

preferably one with its teeth filed off. A blunt pointed straight scissors is pushed under the forceps (Fig. 1) and hugging

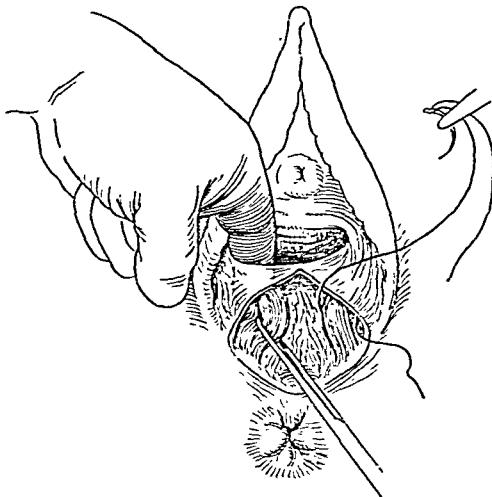


FIG. 3. Showing suture passed through left levator ready to include the right one. The right levator may be pulled forward with the tenaculum or pushed forward with index finger in vagina.

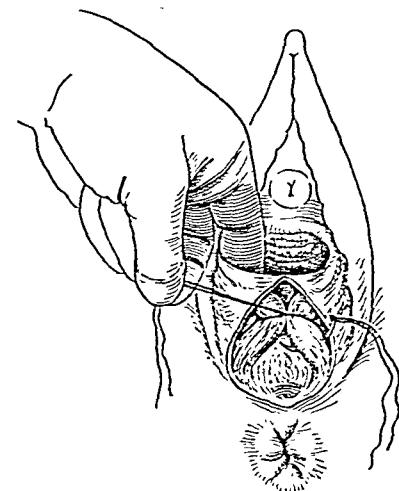


FIG. 4. The first suture tied and its ends used instead of tenaculae to make traction as they are held between the thumb and second finger. This traction is supplemented by the index finger in the vagina pushing the levator forward while the rest of the sutures are inserted. The finger or fingers are changed from right side to left and from left side to right as is called for by the technic of the operation.

The fascia layers are closed in the usual manner excepting that a few strands of the levators are included in each suture. In closing the skin a few small facets of the fascia are included for the same reason, and that is to prevent occult spaces. Several times I have seen the skin and fascia layers broken down but they always reunited within a few weeks without rectocele formation, provided the levators were properly united.

the obstetrician has to do his own draping of the patient and his own needle threading, etc. In view of these obstacles and in the presence of receded levators and often of an impacted and depressed tear which takes place even when an episiotomy has been done, a repair is really all that can be done. The results are almost always good but not better or best. In recent years episiotomies are done in primiparas; but even if they extend into a tear, the technical difficulties for doing a perineorrhaphy remain. A high perineorrhaphy is the only way to prevent cystoceles and cervico-uterine complications.

I have devised a technic in which a perineorrhaphy can be done without assistance if necessary. The crux in its execution is, like in any perineorrhaphy, the isolation and union of the levators to as nearly an antegradid state as possible.

The vaginal mucosa, by blunt dissection, is peeled off its fascial attachment and continued to the posterior aspect of the levators and up to near their pubic insertion. The edge of the mucosa is grabbed, but not clamped, with an Allis forceps,

the undersurface of the mucosa in an opening and closing manner dissection is carried to the desired depth. These steps are successively repeated until the fascia and levators are freed. Should there be a tendency for the mucosa to tear, the tip of the finger can often be used to supplement or supersede the scissors in the process of blunt dissection.

At times the tear or episiotomy or the extension of the same does not reach high enough, thus impeding the isolation of the

posterior aspect of the levators; then the highest point of the tear (Fig. 1) is undermined in the same manner as heretofore and cut in the midline to the desired depth. All this can be done without assistance; in fact it is often as easily done as said because there is a yielding line of cleavage in primiparas. Up to this point the technic is similar to that of any perineorrhaphy except that here it is used immediately postpartum and without assistance. Not infrequently the tear assumes characteristics making the dissection of the mucous membrane unnecessary. With the isolation of the levators the problem remains how to get their thickness into the grasp of the tenaculum without retractor exposure, and a Gelpi retractor proves an encumbrance in such perineorrhaphies. It is then done as follows: The index finger of the left hand at the hindmost edge of the levator (Figs. 2, 3 and 4) pushes it outward and thus facilitates its inclusion in the grasp of the tenaculum. The same thing is done on the opposite levator. Pulling the tenaculum forward, the suture can embrace the whole depth of the levators. When working without an assistant the tenaculums are now removed and this first suture tied. (Fig. 4.) With finger pushing the levators forward, as before, the ends of this first suture, held between the thumb and second finger, are drawn taut while the upper and lower sutures are inserted including their posterior edges. (Fig. 4.) Three to five such sutures are necessary.

Before putting in the lowermost suture both levators are pulled upward, thus releasing and replacing the impacted and

detracted levator fibers holding the anal sphincters. Incidentally, this elevates the lower segment of the tear helping to provide a thicker and firmer perineal base. It also affords a better chance for normal involution of the pelvic floor, and by depleting the engorged hemorrhoidal vessels minimizes the incidence of hemorrhoids. I employ this technic of pulling up the levators in chronic pelvic floor injuries. The fascia and skin are treated in the usual manner with the exception that when uniting the fascia, a few portions of the levator muscles are included. The same principle applies with relation to fascia and skin. This is to prevent a blind space forming in the presence of which the fascia and/or skin sutures infrequently break down. The continuation of the vaginal tear, left behind the levators after the sutures are tied unless it is extensive or bilateral, I leave alone.

In spite of the fact that frank tears and episiotomies are repaired we have a tremendous number of rectoceles and cystoceles with their cervico-uterine complications, etc. Perineorrhaphy instead of perineal repair is indicated. To do a perineorrhaphy takes seven or eight minutes longer than to do a perineal repair; and these are minutes well spent. I often complete the dissection of the mucosa, isolation of the levators and insertion of the levator sutures, without tying, while waiting for the placenta to separate.

#### REFERENCE

1. LITTLE, HERBERT M. *Obstetrics and Gynecology*. Vol. II, chap. XLV, p. 376. Edited by Arthur H. Curtis. Philadelphia, 1934. W. B. Saunders.



# SPINAL ANESTHESIA AND THE SEVERELY WOUNDED\*

LEONID WATTER, M.D.

Attending Anesthesiologist, St. John's Hospital  
BROOKLYN, NEW YORK

THE widespread reluctance to consider spinal anesthesia in the selection of an anesthetic procedure for the severely wounded is of deep concern to many of us who very strongly believe that there is a definite place for subarachnoid block for such type of injuries. This trend became very marked during the past year in which a number of articles on treatment of the severely wounded have completely rejected spinal anesthesia as suitable for them. Curiously enough in none of those articles were there given any statistical data to prove the point, namely, that spinal anesthesia was dangerous in such cases. As a matter of fact, in reports in which such statistical data were presented the figures dealing with spinal anesthesia invariably have shown a higher percentage of survival.

This paper is presented with the hope of giving an unbiased picture of results obtained with spinal anesthesia in sub-standard risks. Unfortunately, we have not had any war experience; in this we seem to be comparable with some of the recent investigators of this problem. We also shall have the temerity of not accepting as final the findings of our British colleagues. With our superior medical organization and a larger number of physicians available for our armed forces we have the right to expect a higher degree of efficiency in our military surgery than that of our allies or enemies. So far the medical reports on our troops are few. That is why we are forced to turn to the statistical data derived from civilian life, such as acute surgical emergencies including gunshot wounds of the abdomen and the obstetrical and gynecological emer-

gencies, because such cases are in many respects similar to the wounds encountered in actual combat.

Our aim is to prove that under similar conditions spinal anesthesia is just as safe as any other form of anesthesia. Notwithstanding the tremendous progress in our surgical methods and technic, the mortality in abdominal wounds has remained practically unchanged during the last twenty-five years. Unquestionably, this is due in some degree to the fact that the fate of an abdominal wound depends not so much upon what can be done by the surgeon as what injuries have been caused by the action of the missile. The refusal on the part of the surgeon to recognize the benefit of spinal anesthesia may have been a factor in keeping our present mortality comparable to that of a quarter of a century ago. We fully realize the handicap that we are facing to substantiate our position. Evans,<sup>1</sup> writing on the anesthetizing of the wounded, specifies that "abdominal wounds required general anesthesia. The patient is usually shocked, and on this account spinal anesthesia is absolutely contraindicated." The J. A. M. A. in one of its recent editorials also emphasizes this point. Gordon-Taylor<sup>2</sup> speaking on amputations states that "in severe shock spinal anesthesia is certain euthanasia." Beecher<sup>3</sup> also comes to the conclusion that "spinal anesthesia is poor choice for surgery for patient either in shock or in impending shock." We regret that in presenting his comparative statis-

\* In contrast to that permit me to quote the title of the following article: Value of low spinal block analgesia in treatment of shock associated with wounds of lower extremities, by A. K. Boyle, Royal Army Med. Corps, 76: 339-340, June, 1941.

ties he limits himself to the fall in blood pressure instead of showing the mortality for the corresponding groups.

Such a juxtaposition of shock and spinal anesthesia is decidedly unfair to the latter because under any conditions it is improper to operate upon a patient who is in shock. Permit me to quote here Sir John Fraser's<sup>4</sup> concluding words from his chapter on the evolution of the abdominal surgery of war: "The theme of this outline of evolution of abdominal surgery in warfare has been to show the necessity for early laparotomy. Lest this be interpreted as rushing the patient to the operating theatre on the earliest moment, . . . it may well be emphasized that such a practice is the antithesis of good judgement. All patients with abdominal wounds will benefit from periods of pre-operative preparation devoted to improving the physical condition. . . . Associated with every case of abdominal wounding there is a measure of shock. . . . Experience has made it abundantly clear that a reasonable time devoted to resuscitation is time well spent." We are quite certain that under such conditions spinal anesthesia will prove to be at least equal to that of any other form of anesthesia.

Both spinal and general anesthesia have their advantages and disadvantages, and a skillfully administered general anesthesia may even be superior to spinal. But it requires a well trained anesthetist; it also requires a rather complicated and cumbersome equipment, although there is no reason why this should not be available even under the most trying conditions. Many of the advantages claimed for open ether anesthesia are fanciful and unsound. That the path of the anesthetist under war conditions is a thorny one is very pertinently illustrated by Muir<sup>5</sup> in his recent report on surgery in the Middle East: "Heat was unpleasant factor in East Africa. A shade temperature of 105-110°F. was common near Cheren. Ether boiled when the cork was removed from the bottle; gas was not available and

chloroform became a necessity. It is not to be recommended for the shocked abdominal patient in whom the surgeon wants relaxation." As to the results of surgery under such conditions Muir states: "I do not think that the operative survival rate for penetrating abdominal wounds in the Middle East would be more than 20-30 per cent and probably less."

In contrast to this, spinal anesthesia, with its utmost simplicity of administration, provides the surgeon with an ideal relaxation so vital for this kind of surgery. With the present accent on youth in our armed forces spinal anesthesia gives our less experienced surgeons and anesthesiologists an opportunity to operate very expertly and expeditiously under most difficult circumstances. With blood transfusions, intravenous therapy, oxygen and the judicious use of vasoconstricting drugs the neurogenic shock of spinal anesthesia can be controlled. It can be easily and safely administered under the blistering sun of the Sahara Desert and in the blinding snowstorm of Alaska. All of the advantages of ordinary spinal anesthesia are increased manyfold by the use of the so-called sustained method as devised by Dr. Lemmon. This method permits the use of minimal quantities of the anesthetic agent and allows an individualization of the dosage, thus making it safe in sub-standard risks.

As to other references, Oberhelman and Le Count<sup>6</sup> report 61.5 per cent mortality in their series of 301 bullet wounds of abdomen. They rather vaguely state that "with few exceptions the anesthetic used was ether." Rippy<sup>7</sup> in his study reports a similar mortality of 61.9 per cent; ether also was his anesthetic of choice. Gordon-Taylor,<sup>8</sup> writing on the surgery of total warfare states that "approximately 50 per cent of the patients with abdominal wounds for whom operation is possible survive." Knowing his attitude toward spinal anesthesia and the general tenor of surgical opinion to it in Great Britain we take it for granted that most of the

operations were performed under general anesthesia. The higher rate of survival here may be attributed to the fact that the highest surgical and anesthetic talents were participating in the treatment of these patients. Rea<sup>9</sup> discussing the treatment of acute abdominal injuries employed at the University of Minnesota Hospital believes that "the type or length of anesthesia are not so important if the patient is given a transfusion during operation." His reported mortality is about 50 per cent. We must confess that so far we have not found any article in which spinal anesthesia is described as the sole anesthetic agent for penetrating wounds of the abdomen. However, in the articles in which both spinal and general anesthesia were used, spinal anesthesia invariably carried a higher rate of survival. Storck,<sup>10</sup> for example, confesses that "the absence of any deaths when spinal anesthesia was employed, either alone or in combination with ethylene or ether, is remarkable even though cases in which spinal anesthesia was employed were those in which there was not a pronounced preoperative depression of blood pressure (10 out of 40 cases)." Hamilton and Duncan<sup>11</sup> also are impressed with the results of spinal anesthesia: a 25 per cent mortality for spinal anesthesia against 43 per cent for general anesthesia. It is interesting that in spite of these rather encouraging figures no one as yet has used spinal anesthesia exclusively in this type of surgery. However, such data are available for other abdominal emergencies. Koster<sup>12</sup> in his report on sixty-nine cases of ectopic pregnancies emphasizes the importance of subarachnoid block for such surgery. In view of the fact that even so-called tragic cases have received spinal anesthesia his record of one death is truly noteworthy. Waters<sup>13</sup> who also uses a great deal of spinal anesthesia states that "it scarcely needs saying that we would have long since given it up had we found the dangers as remotely present as its antagonists contend." Inasmuch as

his report deals with obstetrical and gynecological cases in which loss of blood is an always present danger, the nearly exclusive use of spinal anesthesia in his series of cases speaks for the safety of this method of anesthesia. Graham,<sup>14</sup> speaking on the treatment of perforated duodenal ulcers, strongly emphasizes the correlation between spinal anesthesia and the successful outcome of surgery. Strikingly enough he reports the lowest operative mortality: fifty-one consecutive cases with one death.

As to our personal experience with spinal anesthesia our attitude to it has undergone a considerable change in recent years. Our old objections to its use in shock or acute intestinal obstruction<sup>15</sup> are not valid any longer. In the light of an accumulated experience we have found spinal anesthesia perfectly safe in many desperate cases in which a few years ago we would not dare to employ this form of anesthesia.

This brings us to the most important part of our paper, namely, a plea to be more objective in our evaluation of spinal anesthesia. We have attempted to present a brief survey of the status of spinal anesthesia in acute abdominal surgery, both traumatic and non-traumatic. We are more than certain that spinal anesthesia, carefully administered and properly supervised, in many instances will obviate the difficulties associated with this surgery and enhance its results. We most emphatically disclaim the use of spinal anesthesia as the sole anesthetic method for such surgery. It is merely a plea to consider spinal anesthesia as an important member of our anesthetic armamentarium and not to neglect the benefits that may be derived from its use in acute abdominal surgery.

#### REFERENCES

1. Surgery of Modern Warfare, Edited by H. Bailey, Vol. 1, page 57.
2. GORDON, GORDON-TAYLOR. On amputations. *Lancet*, 1: 669, 1942.
3. Surgery of Modern Warfare.<sup>1</sup>
4. BEECHER, H. K. Anesthesia for seriously wounded. *J. A. M. A.*, 121: 899-903, 1943.

5. MUIR, E. G. Surgery in the Middle East. *Lancet*, 1: 1-3, 1943.
6. OBERHELMAN, H. A. and LE COUNT, E. R. Peace time bullet wounds of the abdomen. *Arch. Surg.*, 32: 373-412, 1936.
7. RIPPY, E. L. Perforating gun shot wounds of the abdomen. *J. A. M. A.*, 115: 1760-1765, 1940.
8. GORDON, GORDON-TAYLOR. The abdominal surgery of "total" war. *Brit. J. Surg.*, 30: 89-107, 1942.
9. REA, C. E. Differential diagnosis and treatment of acute abdominal injuries. *Am. J. Surg.*, 57: 316-320, 1942.
10. STORCK, A. H. Penetrating wounds of abdomen. *Ann. Surg.* 111: 773-819, 1940.
11. HAMILTON, J. E. and DUNCAN, E. Penetrating gunshot and stab wounds of the abdomen. *Surgery*, 13: 107-121, 1943.
12. KOSTER, H. and SHEINFELD, W. I. Ectopic pregnancy. *Am. J. Obst. & Gynec.*, 30: 93-97, 1935.
13. WATERS, E. G. Regional anesthesia: its use in obstetrics and gynecology. *New England J. Med.*, 226: 380-382, 1942.
14. GRAHAM, R. R. The treatment of perforated duodenal ulcers. *Surg., Gynec. & Obst.*, 64: 235-238, 1937.
15. WATTER, L. Observations on spinal analgesia. *Anesth. & Analg.*, 20: 132-141, 1941.



SEPTICAEMIA and Bacteriaemia are due to the presence of organisms in the blood. In the former condition the organisms are not only present in the circulation, but actually proliferate therein.

# FRACTURE OF TIBIA AND FIBULA TREATED BY T AND G BONE PLATE

COMDR. R. D. JOLDERSMA, (MC) U.S.N. RET.

AND

COMDR. F. L. MACPHERSON, (MC) U.S.N.R.

U. S. Naval Hospital

SAN DIEGO, CALIFORNIA

IT is now time to review our results of a year's use of the T and G bone plate, and to evaluate its worth, as well as to

weaker at the site of the screw slot and must be sustained by a screw to get maximum strength. This can be done by putting in a screw at an angle through the line of fracture.

We wish to emphasize what we said in the first article that plating must be done inside of five hours, or the case should be splinted temporarily and not plated for two weeks. The ideal results are obtained when immediate plating is used, but even here great care and judgment must be used to be sure that there is no damage to the skin over the tibial ridge. If in doubt, splint temporarily for two weeks and there will be no cause for regret. If plating is done after five hours and before twelve days, the operation is being done during the inflammatory period of repair. The results will be marked circulatory disturbances of the skin which will take three or four months to overcome, and a resultant marked decrease in callus formation and union, as our case reports will show.

review our results and admit our errors. This article will deal only with its use, as well as its misuse on the tibia. The method of application has been thoroughly covered in the article, "Fallacies of Bone Plating," in the April 1943 issue of *The American Journal of Surgery*, but since that time two errors in its application have shown up:

1. The plate must not be held against the bone with a clamp or bone forceps when it is applied, as the pressure may bend down the side walls and weaken its structural strength.

2. All the screw slots in the plate, especially over the fracture site, must be occupied by screws. The plate is, of course,



FIG. 1. Case 1. Error in plating. Screws were not put through both cortices. This x-ray was taken ten weeks after plating. Patient in walking cast ten weeks. Due to semirigid fixation, callus formed only posteriorly and laterally.

secondary blood supply. So here on the tibial ridge we have an anachronism, a typical "No Man's Land," skin and

Thinking back, we remember that with our previous treatment of fractures with semi-rigid fixation, we obtained callus

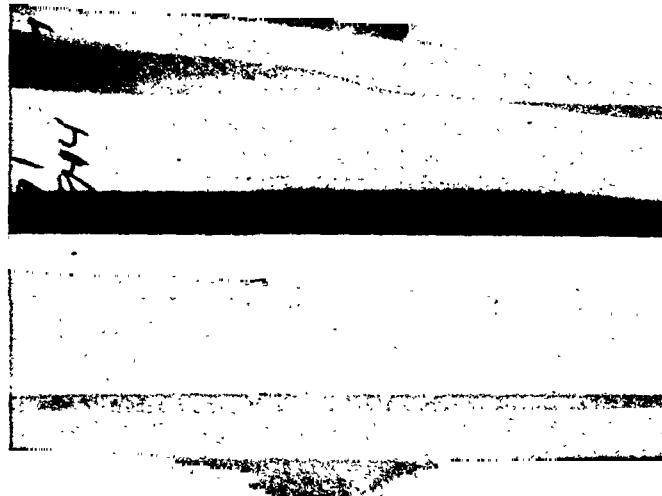


FIG. 2. Case II. Proper plating done on twelfth day. This x-ray was taken twelve days after plating. No cast was used. Callus formed on the anterior and medial borders as well as lateral and posterior edge. This patient returned to full duty in ten weeks.

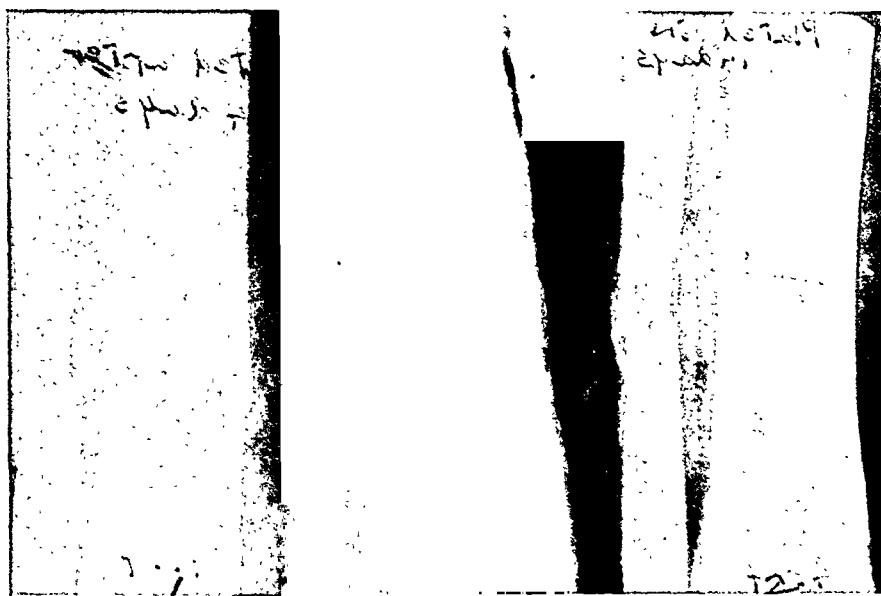


FIG. 3A. Case III. 1, Fracture oblique plated on fourteenth day; 2, three weeks after plating; callus formation and obliteration of fracture lines; patient has full weight bearing. No cast or support was used.

periosteum both with inadequate secondary blood supply depending upon each other for help. The natural deduction, therefore, must be that the primary blood supply of both must be excellent in order to render aid to each other.

laterally and posteriorly early, but very late anteriorly and medially on the tibia. (Case I.) In twenty-one of our cases plated within five hours or after fourteen days, we had rigid fixation and skin with normal circulation, and as a result had

plentiful callus showing in four weeks not only laterally and posteriorly, but also anteriorly and medially, and we also

From the above, the logical deduction using and following the line of physiological reasoning must be that a compound frac-

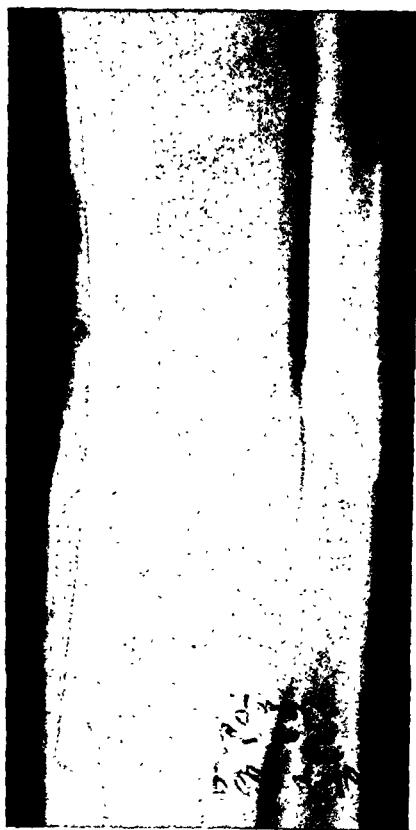


FIG. 3B. Case III. X-ray at nine weeks. Note callus on medial side over plate. Patient was on full duty eleven weeks after fracture.

obtained solid union in eight weeks. (Cases II and III.) When plating was done after five hours and before twelve days, we did not have normal circulation to the skin and as a result the skin in "No Man's Land" formed blebs and broke down. It took three to four months to heal as the periosteum did not get secondary blood supply and the resultant aftermath was that in four or five months we did not have solid union but only callus posteriorly and laterally. (Case I.) Therefore, not only is rigid fixation of the tibia necessary but also normal circulation over the tibial ridge and resultant good secondary blood supply to the periosteum in this region for early repair.



FIG. 4. Case IV. Oblique fracture of lower tibia. The patient also had the tibia fibular ligament torn. Note long lower screw through tibia into fibula holding fibula in place. This x-ray was taken fourth week after plating.

ture of the tibia should never be plated. We not only have destruction of the vital circulation but added to this the disaster of infection.

The skin incision should not be made so it extends onto the tibial ridge or the medial aspect of the tibia where the skin lies directly on the bone. A curved incision should be used on the lateral side and the plate should be applied to the lateral aspect so it will be covered by muscle.

#### CASE REPORTS AND STATISTICS

We wish to call attention to three facts as regards our reports: (1) When we speak of union, we mean not only clinical union, but complete union by x-ray or, in other words, complete obliteration of all fracture line. (2) That as part of the treatment all our patients are given ten to twenty days leave before returning to duty. (3) Return to duty in the Navy means the patient is fit for full manual labor.

Six tibias were plated within the five-hour period and all healed by first intention, had marked callus in four weeks and

blebs, but epidermal cystic pockets of serum along the tibial ridge which had to be opened and drained. No infection was

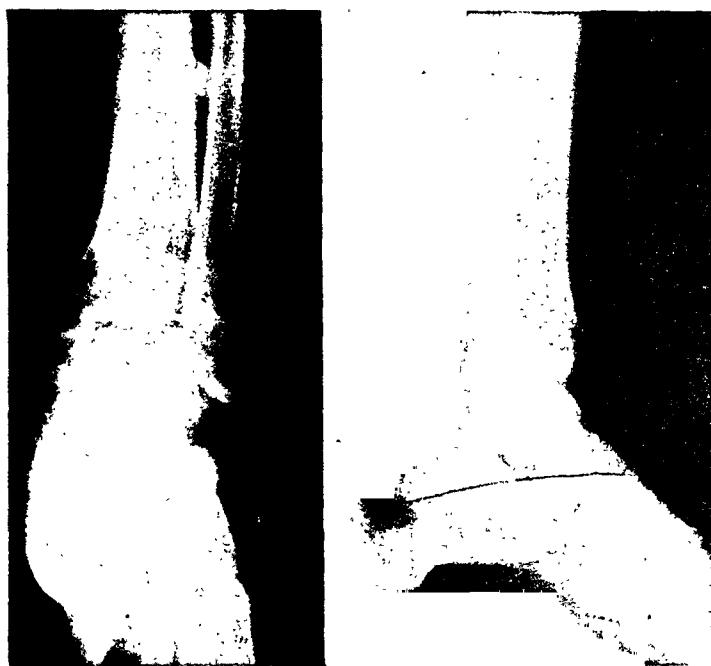


FIG. 5. Case iv. Plate removed at three months as it was near joint. Note union and also callus on medial and anterior border of tibia. No cast or support used at any time.

union in eight weeks. The callus was anteriorly and medially as well as posteriorly and laterally. No casts or any type of support was used and the patients were allowed up on crutches in two weeks and were walking with a cane in four weeks. The average return to duty was eighty-eight days.

Fifteen tibias were temporarily splinted and plated after twelve days. They all had primary union and showed marked callus in three weeks and solid union in six to eight weeks. These fifteen patients were all on crutches in two weeks and walking with a cane in four weeks. They formed callus and had union ten to twelve days earlier than the previous patients so no time is lost in final results of the two weeks' delay. Nearly all of these patients had three weeks leave before return to duty. The average return to duty was three months and eighteen days.

One tibia was plated after thirty-six hours and after two weeks developed, not

present but the skin healed adherent to the tibia. After three months these cystic pockets persisted and the skin had very poor circulation. Therefore, I was influenced by a dictum, "the foreign body was causing this reaction," and so I removed the plate. Due to poor circulation the wound became infected, and at four months the x-ray showed only callus posteriorly and laterally.

One tibia was plated after sixteen hours and healing of the skin was very slow. Edema of the leg persisted and even though non-weight bearing and an Unna paste boot was resorted to it was five months before the circulation returned to normal. At five months the plate was still holding and weight bearing was allowed, but the x-ray revealed callus formation but not solid union and the callus was only laterally and posteriorly.

One compound fracture was treated by débridement, lavage, "holypowder" and cast, and after four weeks apparently well

healed it was plated. But we had the usual story: the secondary circulation was so poor that after three weeks the wound broke down and became infected and the patient is now under the Orr treatment.

*Comparison of Statistics.* During 1941 we had forty-five cases of fracture of both bones of the lower leg. These patients were all treated by the two-pin technic and plaster walking cast. The earliest patient went to duty in five months and twenty-three days. The average return to duty was six and one-half months. This figure does not include the complicated cases.

In 1942, we plated twenty-four tibias, six within five hours, fifteen after twelve days, and the average return to duty was three months and eighteen days. One case, an office worker, forty-two years of age, went to duty in forty-seven days. As in the previous years' statistics the three with complications are not included.

In all six tibias that were plated within five hours we obtained excellent results without any excess callus formation. (Cases II and IV.) This is especially desirable in the case of women. However, in all tibias plated after twelve days excessive callus was thrown down causing a slightly larger limb at the site of fracture. (Case III.) This is, of course, not unusual in other methods of treatment.

#### CAUTIONS

1. Do not plate after five hours or before twelve days.
2. Do not plate when the skin area in

"No Man's Land" is not normal and lacks normal circulation.

3. Do not have the incision run into "No Man's Land."

4. Beware of careless plating and always obtain anatomic reduction and opposition of fragments.

5. A screw running obliquely through the line of fracture is desirable.

6. Always be sure to impact transverse fractures thoroughly before tightening the screws.

7. All slots in plate must be supported by a screw.

Only if careful plating is done, observing the above cautions, will the perfect results and the early union be obtained. In our hands, perfect reduction, early union, maintenance of full function have followed observance of these rules and have shortened the period of disability at least 50 per cent with perfect alignment and length.

We advise as a safety measure the application of a posterior plaster splint for four weeks and then an x-ray will substantiate removal of cast and full weight bearing.

*Warning.* Surgeons who have had considerable experience plating with the other types of plates and screws, may experience some difficulty with this plate and especially the screws, as the technic and method of its use violate all the previous rules, customs and principles. The technic is fully covered in the previous article, "Fallacies of Bone Plating," in the April 1943 issue of this publication.



# AN OPERATION FOR PILONIDAL SINUSES

MAJOR ROLAND W. HIPSLEY, M.C.

14th Evacuation Hospital

CAMP CLAIBORNE, LOUISIANA

THE transition of men from civilian life to active army occupations has produced a change in the concept of what is a satisfactory method of handling pilonidal sinuses. Simple or block excision of a pilonidal sinus, packed open and allowed to heal by growth of granulation tissue has been accepted as the safest surgical procedure in the past. A few surgeons attempted various methods of primary closure in selected cases. These methods varied from simple suture of the fat to the sacrococcygeal fascia to obliterate dead space, to the more complicated plastic flap closure as advocated by Lahey. Recently another type of closure, by cutting out a pad of fat on either wall and suturing the skin edges to the sacrococcygeal fascia has been advocated by DePrizio and McFee. This method is supplemented by skin graft over the sacrum, if needed. The reason, of course, for seeking new methods is because a really satisfactory closure of the cavity left in excising pilonidal sinuses has not yet been found.

Simple or block excision with closure by growth of granulation tissue requires weeks before the final discharge of the patient. This period varies with each patient according to the size of the sinuses, amount of adipose tissue present, and the degree of inflammatory reaction. The average time for complete healing according to most reports has been eight weeks. Some patients with small sinuses heal in four to five weeks. Others have taken as long as a year.

Primary closures, as such, can be used only in selected cases. These cases are few in comparison with the total number of operated sinuses. When they become infected, as they eventually do, if they develop dead space or a hematoma or

both, the period of healing is usually prolonged (over the above group of patients). Most surgeons have had comparatively poor results with primary closures as infections or hematoma develop in as high as 35 per cent of operations. Frequently these are called recurrences. It is believed the condition is not a true recurrence of cyst tissue or even due to the failure to excise cyst tissue. Excision of recurrences in a series of patients reported by Rogers demonstrated the absence of any epithelial tissue in the specimens and showed the so-called recurrences to be due to infected dead space.

The operative procedure advocated by DePrizio and by McFee removed the fat pad from over the sacrum. Lahey called attention to the fact, in 1929, that scar tissue covering for a weight bearing surface is a frequent cause of pain and discomfort while sitting. We have seen two patients who were totally disabled for their army occupation, riding in trucks or jeeps, by the above type of procedure. A personal communication from Lt. Col. Hamilton of the Camp Claiborne Station Hospital to the effect that the complaint of pain on pressure over the sacrum both above and below the site of operation is a frequent sequela following excision of the fat pad, confirms our observation. The army routine, for the vast majority, is a much more active life than previously experienced. The individual is subject to much more trauma especially over the sacrum. While engaged in active field work the opportunities for bathing are greatly reduced. Hence the combination of trauma plus dirt has caused many previously quiescent pilonidal sinuses to flare up with definite abscesses. Lahey stated that he had seen scar tissue break down and become necrotic as a result

of the trauma in this area. Many of the patients seen in army Station Hospitals have been those who have had previously

above conditions. This, on the average, means months of hospitalization.

It is a well known fact that fat has a

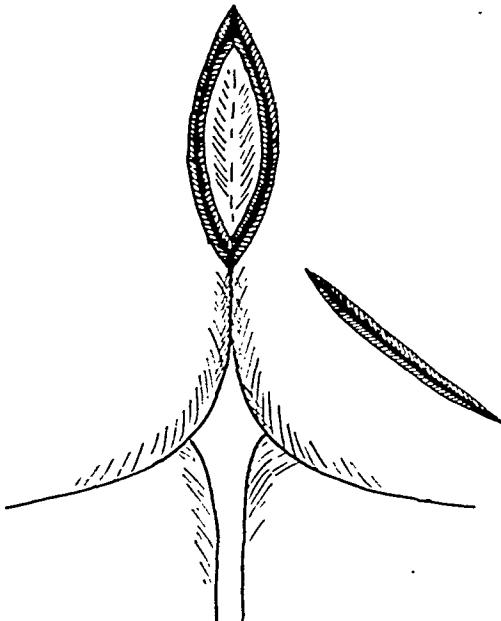


FIG. 1. Incision for pilonidal sinus and lateral gluteal incision for raising muscle flap.

successful excision of their sinuses with no closure attempted. Some of these patients had been operated upon years before with no complications until entering the army. Therefore, it would seem that perhaps one must re-evaluate operative procedures. If an operative scar cannot stand trauma, it may not be a really successful procedure. Certainly, the wounds left open have more scar tissue after final healing than a primarily closed wound. It is therefore, more apt to develop complications under the stress of trauma than the latter procedures.

In civilian life, the patient who has a slowly granulating wound may be out of the hospital in three to eight days and back at work. Army life places such demands on the average soldier that he must be physically fit. Hence his wound must be healed and strong enough to resist trauma, increased perspiration, and opportunities of infection before he can be discharged from the hospital. The hospitalization, therefore, must not only cover his wound healing, but also give a chance for the scar to become firm enough to resist the

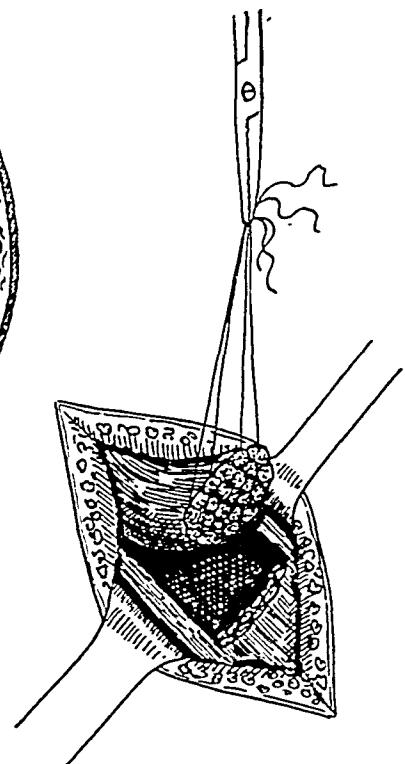


FIG. 2. Flap of gluteus maximus muscle cut and raised from bed.

poor blood supply and has very low resistance to infection. Scar tissue also has markedly decreased vascularity. It was believed, therefore, that if a tissue with an adequate blood supply, resistant to infection could be transplanted to fill the space left by the excision of the cyst, it might improve the healing, decrease the chances of infection and obliterate the dead space. It would also protect the sacrum with an adequate pad. On this basis of reasoning the following operation was tried on a patient:

Under spinal anesthesia, the pilonidal sinus was excised with an electric knife according to the method advocated by Rogers. This left a moderate size cavity extending over the lower sacrum and coccyx and exposing the sacrococcygeal fascia. This wound was packed with saline packing and a three-inch incision was

made laterally just above the ischial tuberosity in the line of fibers of the gluteus maximus muscle. The muscle was dis-

We did not cut any large arteries and the blood and nerve supply was still intact at the end of the procedure. The gluteus

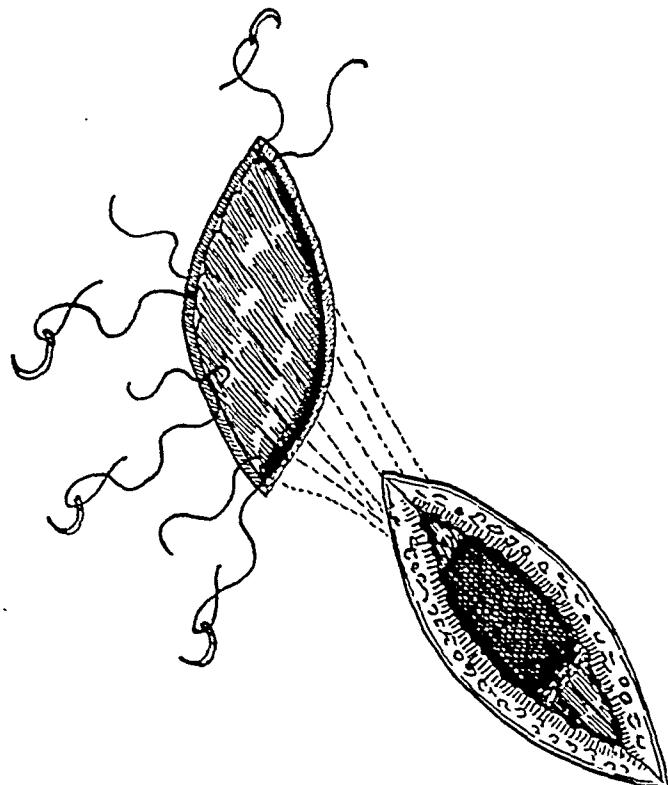


FIG. 3. Pedicle muscle flap passed through subcutaneous tunnel and sutured in place in cavity left by removal of pilonidal sinuses.

sected free of fat, exposing an area as wide as the cavity was long. A flap of muscle sufficiently thick almost to fill the cavity and long enough to be turned over and reach the opposite wall of the cavity without tension, was freed as shown in Figure 2. A tunnel was then fashioned in the fat tissue under the intervening skin and the free muscle end passed through it. The proximal end of the muscle was left intact, using it as a pedicle flap. The muscle flap filled the cavity to just below the skin edges. Cotton sutures were taken through the base of the lower and upper angles and two along the intact lateral wall. The skin was then closed loosely. The gluteal incision was closed with deep and superficial cotton sutures to obliterate dead space and the skin closed with cotton. A pressure dressing with a sea sponge completed the procedure.

maximus muscle has a very adequate blood supply from the inferior and superior gluteal arteries and it was reasoned that the excellent vascularity would promote healing and combat infection, while the intact nerve supply might prevent subsequent atrophy and fibrosis of the pedicle flap.

This procedure has been performed by the author on six patients at the Station Hospital, Camp Claiborne, Louisiana. A short summary of their postoperative course is appended:

J. S. was operated upon February 27, 1943. A primary closure was attempted. There was a slight serous discharge with an odor on the fourth postoperative day. The sutures were removed and the wound opened down to the muscle. There was no infection present but a moderate necrosis of the subcutaneous tissue presumably secondary to the use of the electric

knife. The wound was cleaned and left open. On the seventh postoperative day, the incision over the ischial tuberosity was healed and the sutures were removed. The sacral wound was clean and without odor or discharge. By the fourteenth postoperative day the sacral wound was healed and epithelializing. This wound was entirely healed on the eighteenth postoperative day with a solid scar.

W. B. was operated upon March 15, 1943. A delayed primary closure was attempted on March 16, 1943. The gluteal wound healed by primary union in seven days. The sacral wound showed some redness of the skin edges when dressed on the fourth postoperative day. The sutures were removed and a small hematoma was found to have formed between the upper surface of the muscle flap and the subcutaneous tissues of the dermis. This was evacuated. The wound was dressed again on the sixth postoperative day and it was clean without any odor or discharge and healing. This wound was all healed except for the upper angle by the fourteenth day postoperatively. The upper angle of the wound had a deep coagulation of the entire skin thickness and subcutaneous tissues due to an error in technic in the use of the electric knife. This area slowly sloughed out and healed to a depth of about an inch by granulation. This wound took the longest to heal completely, about thirty days due to this error.

M. K. was operated upon March 15, 1943. In the previous two patients, the remaining muscle from which the pedicle flap was removed had the cut ends sutured. M. K.'s cut muscle ends were not sutured because the field was dry when the gluteal wound was closed by delayed primary closure. A two day delayed closure was tried in an effort to avoid the hematoma and serous discharge. The latter was incidental to the use of the electric knife in the block excision. The muscle ends of the pedicle flap constantly oozed during the operations and no attempt was made to control this. It was believed that any suture to the muscle to control this oozing would result in muscle necrosis. On March 18, 1943, the acriflavine gauze packing was removed from both wounds. The wounds were clean and had no odor. There had been considerable oozing of blood judging from the dressings. The sutures which were inserted at the time of operation were tied. Three days later there was a foul smelling dis-

charge from the sacral wound. The sutures were removed from this wound. The gluteal wound looked clean. On March 22nd, two days later, the sacral wound was clean and healing, but the gluteal wound was indurated. Probing revealed a hematoma. The sutures were removed and the hematoma evacuated. The gluteal wound healed uneventfully following this but the sacral wound developed a deep stitch abscess where the muscle flap had been sutured, which was evacuated and the cotton suture removed. These wounds were healed, despite the complications, by the twenty-first postoperative day.

W. S. was operated upon March 17, 1943. A delayed primary closure was performed on both wounds on March 18, 1943. The sacral wound of this patient was healed and epithelializing by March 23rd. Again the cut muscle ends of the gluteus maximus, remaining *in situ*, were not sutured and again a hematoma formed in the gluteal wound and had to be evacuated. This wound took longer to heal due to the complications than the sacral wound.

The postoperative courses in these four patients apparently showed that the cut muscle ends of the gluteus maximus should be sutured even though apparently dry. The electric knife seemed to be contraindicated in the original block dissection because it caused subsequent edema. The oozing of the transplanted muscle contraindicated primary closure. The healing was so rapid even after the wounds were opened that it suggested the advisability of leaving the sacral wounds open, not even attempting a delayed primary closure.

Two patients who had undergone one and two previous operations, respectively, were operated upon with the removal of a large area of chronic inflammatory tissue, leaving a wound extending from the sacrum down to the anal canal exposing rectum and laterally well over the gluteal muscles. Large flaps of gluteal muscle were sutured into these cavities. Due to their large size, it was possible to cover the length of the cavity, but only about half filling their depth. The sacral wounds were left open and lightly filled with acriflavine gauze packing.

Both these patients developed hematomas in their gluteal wounds. Both were put on sulfanilamide therapy. Dressings on the second and fourth day showed the sacral wounds, which were not sutured, healing and clean. The gluteal wound of one patient became infected, the other was not infected. The encouraging feature was the clean sacral wounds which had already started healing. A check on the tenth postoperative day showed both sacral wounds clean and nearly closed.

Sulfanilamide, orally, was used in the first patient operated upon. No sulfanilamide therapy was used in the next three patients in an effort to evaluate the effect of the increased vascularity on infection. Sulfanilamide therapy, orally, was used in the two patients operated upon for recurrences.

This report shows we did not succeed in performing one primary closure. However, these patients cleared their infections and hematomas rapidly. There was apparently no marked loss of time due to failure of primary closure. The first four patients all entered the hospital with acutely infected cysts. Three to four days were allowed to elapse before operation. A longer time was indicated. The scars of the two healed patients were narrow linear scars. There was a good pad over the sacrum. The patients were asked particularly if this pad felt uncomfortable. Each answered in the negative. A striking feature in the postoperative course was the lack of bad odor and sloughing. In the case in which it was present, the odor disappeared within two days after opening the wound. We present this paper as a preliminary report describing the operation. It was thought the procedure showed enough promise to warrant this early report in the hope that a larger experience could be obtained from other surgeons.

Whether this procedure will stand up under the stress and trauma of army life can only be decided after a long follow-up.

A follow-up by the average station hospital on operated cases can scarcely be longer than six months. New procedures evaluated on the basis of short postoperative observation may have to be revised after analyzing statistics from a number of station hospital records. Camp Claiborne Station Hospital has received a number of patients, apparently successfully operated upon within a period of six months, and showing sinus recurrence on admission. The recurrence was usually apparent only one to two days prior to admission. Consequently, all reports must be analyzed critically from this viewpoint.

In the small series of patients operated upon, several points in this technic seem quite important: (1) The muscle flap must be adequate to fill the cavity, and the subcutaneous canal large enough not to constrict the muscle and decrease its vascularity. (2) The floor of the canal should be flush with the surface of the sacrococcygeal fascia to obliterate adequately dead space. (3) The block dissections of the sinus should be performed with the scalpel. (4) Leaving the sacral wound open and obtaining approximation of the skin edges by adhesive strapping seems to be the procedure of choice. This seems indicated because the oozing from the cut muscle ends invariably formed hematomas in the closed wounds.

#### SUMMARY

A preliminary report is presented to give a procedure that shows promise in the operative treatment of pilonidal sinuses.

I wish to express my appreciation to Colonel Lucius F. Wright, Commanding Officer, Camp Caliborne Station Hospital for his permission to conduct this work; Lieut. Col. A. Scott Hamilton, Chief of the Surgical Service, for his hearty co-operation and helpful advice, also Colonel Leonard N. Swanson, Commanding Officer, 14th Evacuating Hospital, for the assignment to the Station Hospital and his keen interest in this problem.

# RETROPERITONEAL MUCOCELE OF THE APPENDIX

## CASE REPORT

WILLIAM H. MYERS, M.D.

AND

RUTH F. ROMINGER, M.D.

On Staffs of Moline Public and Lutheran Hospitals

On Staffs of Moline Public and Lutheran Hospitals

COAL VALLEY, ILLINOIS

**M**UCOCELE of the appendix is the name applied to a condition in which there is an accumulation of mucoid material either in the lumen, the wall, or in a diverticulum of the appendiceal wall. When it ruptures it produces the condition called pseudomyxoma peritonei. The latter may also be caused by the rupture of certain types of ovarian cysts.

The following case is described not only because of the rarity of the disease but because of the large size and the most unusual position of the mass. The location of the mucocele adds one more condition to be considered in a differential diagnosis of right-sided tumor masses, particularly when retroperitoneal.

### CASE REPORT

W. P., male, age seventy-two, widower, was first seen October 7, 1940. His chief complaint was attacks of pain in the right side of the abdomen, increasing in frequency and severity for the past two years. During the past week he had two severe attacks which persisted for twelve to twenty-four hours and had been accompanied by nausea but no vomiting. He had noticed some tenderness in his right side during the past year and thought his right side was enlarging slowly. His bowels had always been constipated and he used laxatives regularly. There had been no urinary disturbances. His weight had not changed during the past five years.

The past history revealed nothing of note except that at the age of about thirty years he had an attack of severe pain in the right lower quadrant which had gradually subsided but which had disabled him for several weeks.

Examination revealed a rather thin white male about seventy years of age, seventy-two inches in height, weighing one hundred forty-

five pounds. General examination was essentially negative with exception of the following.

The abdomen was moderately distended. The entire right side was definitely and uniformly bulging. There were no varicosities or visible peristalses. On palpation a mass was felt, firm but somewhat elastic, extending from the right groin to the costal margin and from the right flank posteriorly to the midline anteriorly. It was slightly movable. It did not move on respiration. Auscultation of the abdomen was normal.

Rectal examination was negative except for palpation of a firm rounded mass extending upward from just below the pelvic brim on the right side.

Blood count showed a moderate secondary anemia; hemoglobin (Sahli) 74 per cent, erythrocytes 3,850,000, leukocytes 9,200. The urinalysis was negative.

Intravenous pyelogram showed normal functioning kidneys with pelvis and ureters of normal size and position. In these films could be seen a shadow extending upward from the right iliac fossa to above the costal margin and extending from the midline to the right flank. The psoas shadow was obliterated on the right. Throughout the shadow were diffuse areas interpreted as calcification.

Gastrointestinal series was normal with the exception of the examination of the colon. The cecum and ascending colon were displaced to the midline. On palpation they were somewhat movable but could not be replaced laterally. The outlines were regular, there were no filling defects or obstruction. The appendix could not be visualized.

The impression gained from the study of the history, examination and x-ray evidence was that the right-sided mass was retroperitoneal, was not renal nor intestinal in nature, and was probably not malignant because of the size, duration, and generally good condition of the patient. Because of the considerations, it was advised that he undergo operation.

Operation was performed October 18, 1940, at the Lutheran Hospital, Moline, Illinois, (Case No. 46,122) under novocaine spinal anesthesia, assisted by Dr. H. C. DeBourcy.

A right kidney incision was used extending the incision forward to about 4 cm. below and anterior to the anterior spine. The peritoneal cavity was not opened at any stage of the operation.

The retroperitoneal mass was exposed carefully and found to be cystic in nature. It extended upward far above the costal margin, covering the entire anterior surface of the right kidney and the ureter, downward to below the brim of the pelvis and medially to the midline where its anterior and medial walls were in close apposition to the colon and peritoneum.

The cyst could not be removed intact because of its size and the friable nature of its wall. On attempting to aspirate, much difficulty was encountered because of the thick and tenacious character of its contents. The contents varied from clear thick mucoid material to thick grayish material in suspension resembling fish eggs. After the contents were removed, the wall was freed without great difficulty beginning above, working downward carefully to avoid injury to adjacent structures. As the right iliac fossa was reached the large cystic sac suddenly narrowed to a tube, firm, muscular, lead pencil in diameter and about 8 cm. in length. This was followed to its origin which proved to lead to the cecum at the end of the *tenia libera*, where it was clamped and ligated.

Up to this point no diagnosis had been made as to the cyst origin. It was now clear we had to deal with an enormous mucocele of the appendix, retroperitoneal in location.

The incision was sutured in layers with chromic catgut, one penrose tube being placed to drain the cavity.

Convalescence was uneventful, the patient being discharged from the hospital November 3, 1940, in good condition but with slight drainage from his wound. This persisted for six weeks when it finally healed and has remained so. When last heard from October, 1942, he was in good health.

The laboratory report of Dr. M. J. Vollmer, pathologist of the Lutheran Hospital, was as follows: "The gross specimen, cyst wall, weighed 212 grams, the mass being made up of the thickened wall of a cavity holding mucoid

material. Bits of myxomatous tissue still adhere to its inner surface. Parts of the wall show calcareous deposits.

"Microscopically the sections show mucous deposits in the tissue cells. There is an inflammatory process accompanying, producing adhesions, but there is no invasion into surrounding organs. The sections of the small tube appear to be an appendix-like structure showing a circle of lymphatic tissue, but there are no glands of the normal mucosa. Here the connective tissue has increased greatly but there does not appear to be any neoplastic change. There is myxomatous degeneration but not the appearance of the mucous tissue as found in the cyst wall proper. Diagnosis: Retroperitoneal mucocele of the appendix."

Mucocele of the appendix was first described as a pathologic entity by Rokitansky in 1842. Virchow, in 1863, considered it a colloidal degeneration of the appendix. Werth, in 1884, described the finding of mucoid material in the peritoneal cavity and ascribed it to the rupture of a pseudomucinous cyst of the ovary. Fränkel, in 1901, described the same condition due to a ruptured cystic appendix in a male patient. In 1916, Dodge was able to find only 142 cases in the literature. Ninety authentic cases of pseudomyxoma peritonei of appendiceal origin were reported by D'Aunay and Fine in 1934.

Castle in 13,158 necropsies reported .2 per cent mucoceles. Normant in 45,000 Mayo Clinic cases found thirty-six mucoceles. Mayo and Foster report seventy-six cases in 31,200 appendectomies from 1917 to 1930. Jirka and Scuderi in 1938 reporting Cook County Hospital cases found four at 9,180 postmortem examinations and twenty-two mucoceles in 9,535 appendectomies, in the years 1929 to 1937. Weaver, in 1937, found seven cases in 6,225 operations and reported 256 cases from the literature.

Age probably has no etiological significance, cases having been reported from four years to over seventy-two years. Most cases, however, occur after middle age.

Woodruff and McDonald report seventy-nine cases in females and fifty-seven in males, a ratio of females to males of 1.4 to 1.0. Latimer reports the ratio of females to males as being one to two.

A stenosis of the appendiceal lumen usually caused by an inflammatory process produces an occlusion which holds back the glandular secretion. This in the presence of relatively sterile contents slowly produces a mucocele. Most cases will probably be found to have had old or recent inflammatory attacks which have regressed. Occasionally, malignant changes in the wall or a kink will produce the condition. Doyle speaks of a normal obliteration of the mucosa of the appendix after middle age, which if it begins near the cecum causes an obstruction which may lead to mucocele formation.

Naeslund was able to produce the condition experimentally in newborn rabbits by ligation of the appendix. The appendix was severed distal to the ligature leaving the distal stump open. In most cases small mucous cysts lined with epithelium were formed. Some of these burst and mucous material spread over the peritoneum. Phemister was unable to produce cysts by ligation of the appendix in dogs. Wangensteen, by a ligation method, was able to produce an acute appendicitis, but did not report chronic cystic formation.

Practically all cases show evidence of old or recent attacks of inflammation in the wall of the appendix. Most cases show evidence of stricture resulting from these inflammatory attacks. The majority of cases give a history of preceding appendiceal attacks. Inflammation is the most definite and most frequent factor in the production of a mucocele.

Grossly the size varies from a normal sized appendix to one of the great size encountered in this report. The shape varies according to the size and location of the cystic areas. The color and consistency vary from normal to grayish white and from normal softness to firm

distention with hyaline changes in the walls. There may be softened areas, preliminary to rupture, or actual rupture with extrusion of the mucoid contents into the peritoneal cavity.

Histologically, simple mucoceles vary from almost normal mucous membrane to thin, membrane-like walls filled with hyaline. There is usually a predominance of mucous cells. There may be areas of wall where cell changes of adenocarcinoma have occurred. It has been suggested by Woodruff that the cases of the pseudomyxoma peritonei which run a fatal course are of this type. In the simple type, rupture into the peritoneal cavity before or during operation is usually benign in its course.

The symptoms of mucocele are very vague and indefinite. A preoperative diagnosis has rarely been made. Lifvendahl reports such a case.

A dull pain in the right lower quadrant associated possibly with some digestive or bowel disturbance has been noted frequently. A palpable mass, when the mucocele is of some size, may be noticed by the patient. This was observed in a previous case reported by the author.

The physical findings are few. Of main interest is the palpation of a mass usually in the right side of the abdomen. It may be fixed or movable, firm and elongated or rounded in shape.

X-ray may reveal a filling defect of the cecum, sometimes a partial filling of the appendiceal cyst. Pugh reports multiple areas of calcification in a case of pseudomyxoma peritonei.

The diagnosis is based upon a past history of preceding attacks of appendicitis, indefinite abdominal distress with often a palpable mass in the right side which may be fixed or movable, and of varying shapes and sizes, but usually long and sausage shaped, and negative x-ray and urological evidence of the more frequent causes of the symptomatology. Most cases have been diagnosed at laparotomy, often done for entirely different lesions, the

mucocele having been discovered as an incidental finding, particularly those of small size. Recently Pugh has described a case in which characteristic findings of calcification in multiple cysts of the peritoneum were noticed on x-ray.

The treatment is entirely surgical and varies from simple appendectomy to more extensive resections of the cecum and ileocecal region in complicated cases. Where a simple mucocele has ruptured, mopping up of the mucoid material may be sufficient. In a more extensive and probably malignant degeneration, it may be impossible to remove even a small portion of the exudate. Radiation therapy post-operatively may be of some value, but usually gives no permanent benefit.

#### SUMMARY

1. A retroperitoneal, retrocecal mucocele of the appendix of great size was successfully removed in a patient seventy-two years of age.

2. The size and retrocecal location are unusual and rare.

3. Mucocele of the appendix must be considered in a differential diagnosis of right-sided masses both abdominal and retroperitoneal.

4. A résumé of the literature and fairly complete bibliography are given.

#### REFERENCES

- ALBERTI, V. *Policlinico*, 38: 265-277, 1930.  
 ALT, L. *Beitr. z. klin. Chir.*, 156: 114-446, 1932.  
 ANTOINE, T. *Zur Frage Des Pseudomyxoma Peritonei. Ztschr. f. Geburtsch. u. Gynäk.*, 111: 37, 1935.  
 ARERLUND, *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 26: 327-334, 1918.  
 ASCHOFF, L. *Spezielle Pathologische Anatomie, in Pathologische Anatomie, Ein Lehrbuch für Studierende und Aerzte*. ed. 3, Jena, 1913. Gustav Fischer.  
 BAILEY, F. W. *Pseudomucinous cysts of the appendix and ruptured pseudomucinous ovarian cyst*, *Surg., Gynec. & Obst.*, 23: 219, 1916.  
 BEER, E. H. *Am. J. M. Sc.*, 128: 135, 1904.  
 BEHREND, C. M. *Arch. f. klin. Chir.*, 168: 651-657.  
 BELL, T. F. *West. J. Surg.*, 47: 597-603, 1935.  
 BIRCHENFELD, W. *Zentralbl. f. Chir.*, 58: 210-213, 1931.  
 BOYD, W. *Surgical Pathology*. 2nd ed., pp. 376-381. Philadelphia, 1929. W. B. Saunders Co.  
 CAMPANA, M. *Morgagni*, 74: 1147-1149, 1932.  
 CASE, J. T. *Am. J. Roentgenol.*, 3: 316-326, 1916.  
 CASE, J. T. *Diverticula of the small intestines other than Meckel's diverticulum*, *J. A. M. A.*, 75: 1483, 1920.  
 CASTLE, O. L. *Cystic dilatation of the vermiciform appendix*, *Ann. Surg.*, 61: 582-588, 1915.  
 CHASE, W. H. *Canad. M. A. J.*, 17: 416, 1927.  
 CHRISTOPHER, F. *Mucocele of the appendix*, *Minnesota Med.*, 9: 265, 1926.  
 CLELAND, J. B. and STEEMAN, J. G. *Pseudomyxoma peritonei of appendiceal origin*, *M. J. Australia*, 1: 721, 1927.  
 COLLINS, D. C. *Ann. Surg.*, 104: 100, 1936.  
 CORNING, ERASTUS. *Retention cyst and diverticulum of the vermiciform appendix*, *Albany M. Ann.*, 26: 816-831, 1905.  
 CRAIG, PAUL E. and FORTNER, CHARLES H. *Mucocele of the appendix: a case report with review of the literature*, *J. Kansas Med. Soc.*, 39: 92, 1938.  
 CRAN, B. S. *Lancet*, 1: 395, 1934.  
 CRISTELLER, E., HENKE, F. and LUBARSCH, O. *Handbuch der Speziellen Pathologischen Anatomie und Histologie*, Berlin, 1929, Julius Stranger.  
 CRUVEILHEIR, quoted by Hyvernand.  
 DANNREUTHER, W. T. *Mucocele of the vermiciform appendix*, *Am. J. Obst. & Gynec.*, 31: 342, 1936.  
 D'AUNDY, RIGNEY and FINE, ARCHIE. *Pseudomyxoma peritonei of appendiceal origin; survey of the literature and report of a case*, *Am. J. Cancer*, 22: 59-65, 1934.  
 DAVISON, M. *Mucocele of appendix*, *Internat. Chn.* 2: 303-309, 1922.  
 DEAVER, J. B. *A Treatise of Appendicitis*. Philadelphia, 1900. P. Blakiston's Son & Co.  
 DEAVER, J. B. *Appendicitis: Its Diagnosis and Treatment*. 4th ed., pp. 107-108. Philadelphia, 1913. P. Blakiston's Son & Co.  
 DE LA GUARDIA, J. *United Fruit Co., Med. Dept.*, 209-212, 1928.  
 DEWEY, J. E. and WAKEMAN, J. N. *J. Missouri State Med. Ass.*, 1924.  
 DIETEL, F. G. *Zentralbl. f. Gynäk.*, 54: 2389-2393, 1930.  
 DODGE, G. E. *Cystic dilatation of the vermiciform appendix*, *Ann. Surg.*, 63: 334-348, 1916.  
 DONAT, Arch. f. Gynäk., 26: 478, 1885.  
 DOYLE, JAMES C. S. *Calif. Med.*  
 EASTON, E. R. *Med. J. & Rec.*, 138: 463, 1933.  
 EDEN, T. W. *A case of pseudomyxoma of the peritoneum arising from perforation of gelatinous ovarian cyst and associated with similar cystic disease of the vermiciform appendix*, *Lancet*, 2: 1498, 1912.  
 ELBÉ, *Appendixcysten und Divertikel*, *Beitr. z. klin. Chir.*, 64: 635, 1909.  
 ELLIOTT, C. B. *Ohio State M. J.*, 36: 629-630, 1940.  
 EWING, JAMES. *Neoplastic Diseases*, 3rd ed. Philadelphia, 1928. W. B. Saunders Co.  
 FERÉ, *Mucocele de l'appendice ileocaecal*, *Proc. Med.*, 5: 73, 1877.  
 FERG, E. J. and CHESTNUT, W. A. *Canad. M. A. J.*, 12: 108-109, 1922.  
 FISCHER, HERMANN. *Cyst of the appendix*, *Ann. Surg.*, 64: 735-736, 1916.  
 FORSELL and KEY. *Nord. Med. Ark.*, 2: 1-2, 1915.  
 FOUSER, RALPH H. *Chronic inflammatory tumors of the ileocecal segment*, *Am. J. Surg.*, 49: 124-128, 1940.

- FRÄNKEL. Ueber das Sog. Pseudomyxoma Peritonaei. *München. med. Wochschr.*, 1: 965, 1901.
- Quoted by Garnier, Paul Les Diverticules Des Troisième et Quatrième Portiones de Duodenum, Thèse de Paris, 1925.
- GERBATSCH, G. *Beitr. z. klin. Chir.*, 154: 169-170, 1932.
- GINSBURG, N. Pseudomucinous cyst of the appendix complicating ruptured ectopic gestation. *Ann. Surg.*, 64: 65-85, 1917.
- GORDHAM, A. J., CHOYCE, C. C. and RANDALL, MARTIN. Diverticulosis of the appendix and pseudomyxoma peritonei, *Brit. J. Surg.*, xvi, 62-68, 1928.
- GRODZINSKY, MANUEL and RUBNITZ, ABRAHAM. Mucocele of the appendix and pseudomyxoma peritonei. *Surg., Gynec. & Obst.*, 73: 345-354, 1941.
- GULLMAN, P. *Deutsche med. Wochenschr.*, 17: 260, 1891.
- HALL, D. P. Mucocele of appendix with mass in cecum. *Int. Med. & Surg.*, 47: 169-172, 1934.
- HAMMARSTEN. Quoted by Lewis, *Surg., Gynec. & Obst.*, pp. 757-760, 1914.
- HARNEK, M. *Monatschr. f. Geburtsch. u. Gynäk.*, 66: 345-350, 1924.
- HARTMAN and BINET. *Ann. de gynéc. et d'obst.*, pp. 66, 73, 75, 77, 1918.
- HAUSMAN. *Virchow's Arch f. path Anat.*, 164: 400, 1896.
- HENKE-LUBARSCH. Handbuch der Speziellen Pathologischen Anatomie und Histologie, Berlin, 1929. Julius Springer.
- HENTZ, G. *Ann. Surg.*, 96: 456-469, 1932.
- HESCHL. *Wien. med. Wochenschr.*, 30: 540, 1880.
- HOBART, M. H. and NESSELROD, J. P. J. A. M. A., 100: 31-33, 1930.
- HORNING, R. *Zentralbl. f. Gynäk.*, 52: 1630-1634, 1928.
- HOSSOI, E. *Arch. Path.*, 16: 500, 1933.
- HYVERNAND. Le Pseudomyxoma D'origine Appendiculaire. Thèse de Paris, p. 26, 1919-1920.
- IRSIGLER, F. J. *Zentralbl. f. Chir.*, 58: 413-415, 1931.
- JACKSON, ARNOLD. *Wisconsin M. J.*, 35: 633, 669, 1936.
- JEFFRIES, J. W. *Ann. Surg.*, 96: 215-218, 1932.
- JIRKA, F. J. and SCUDERI, C. S. Mucoceles of the appendix, *Illinois M. J.*, 73: 57, 1938.
- JONES, T. E. and CARMODY, M. G. Mucocele of the appendix. *Am. J. Surg.*, 32, 511, 1936.
- KAUFMANN, EDWARD. Path. 2. Philadelphia, 1929. Phil. P. Blakiston's Son & Co.
- KELLY, H. A. and HURDON, E. The Vermiform Appendix and Its Diseases. Philadelphia, 1905. W. B. Saunders Co.
- KELLY, H. A. Appendicitis. Philadelphia, 1909. W. B. Lippincott & Co.
- KEMKER, H. *Deutsche Ztschr. f. Chir.*, 23: 481-497, 1932.
- KENNEDY, JAS. W. Pract. Surg. of the Jos. Price Hosp. Philadelphia, 1926. F. A. Davis Co.
- KLINE, L. B. *Mil. Surgeon*, 77: 275, 1935.
- KONJELZNY, G. E. *München. med. Wochenschr.*, 56: 2251, 1909.
- KROGIUS, A. *Deutsche Ztschr. f. Chir.*, 200: 273, 1927.
- KROSS, ISIDOR. *New York State Med. J.*, 38: 1185, 1938.
- KRUBBEL, M. *Beitr. z. klin. Chir.*, 80: 121, 1912.
- LATTIMER, E. O. Mucocele of the appendix, *Am. J. Surg.*, 47: 124-127, 1940.
- LAZAREVIC, V. *Zentralbl. f. Chir.*, 55: 1877-1880, 1928.
- LENNANDER. Volkmanns Sammlung Clin. Vortrage, No. 75, 1893.
- LEONARDO, R. A. *Am. J. Surg.*, 22: 290-294, 1933.
- LEORAT, M. L. *Rec. de Chir.*, 63: 296-305, 1925.
- LEPOURTE and DELOTTRE. A case of cystic appendicitis. *Bull. et Mém. Soc. de Chir. de Paris*, 49: 330-332, 1923.
- LIMITO, C. Mucocele of the vermiform appendix. *Med. Ital.*, 13: 642, 1932.
- LEWALD, Quoted by Vorhaus.
- LIEBLEIN, V. *Beitr. z. klin. Chir.*, 147: 179-199, 1929.
- LIFVENDAHL, R. A. and RIES, E. Open communication between mucocele and appendix. *Am. J. Surg.*, 17: 270-274, 1932.
- LODGE, G. E. Cystic dilatation of the vermiform appendix with study of 142 cases. *Ann. Surg.*, 63: 334, 1935.
- LOHR. *Deutsche Ztschr. f. Chir.*, 171: 30, 1921.
- LORENZETTI, C. *Clin. Chir.*, 33: 987-1020, 1930.
- MACCARTY, W. C. and MCGRATH, B. F. Clinical and pathological consideration of obliterative carcinoma and diverticulum of the appendix. *Surg., Gynec. & Obst.*, 12: 211-220, 1911.
- MCCONNELL, M. G. *Intern. Clin.*, 4: 153-163, 1907.
- MCWILLIAMS, C. A. *Am. J. Med. Sc.*, 135: 822-850, 1908.
- MACEWEN, J. A. *Lancet*, 2: 571, 1917.
- MARGULIES, H. *Arch. f. klin. Chir.*, 174: 98-106, 1933.
- MARTIN, E. K. Mucocele of appendix, atlas of pathological anatomy. *Brit. J. Surg.*, 21: 354, 1934.
- MASSON, J. C. and HAMRICK, R. A. Pseudomyxoma peritonei; originating from mucocele of the appendix. *Surg., Gynec. & Obst.*, 50: 1023-1029, 1930.
- MAYDL, K. Die Klinische Erscheinung des Hydrops Processus Vermiformis. *Allg. Wien. med. Ztschr.*, 37: 465, 1892.
- MAYO, C. J. and FAUSTER, J. W. Mucocele of appendix with report of a case. *Minnesota Med.*, 15: 254, 1932.
- MERTENS, H. Med. A. D. Grenzyebd. Med. U. Chir., 9: 743, 1902.
- MEYER, WILLY. Giant mucocele of the appendix. *Proc. N. Y. Surg. Soc.*, 1: 317, 1912.
- MICHAELSON, E. *Acta chir. Scandinav.*, 68: 37-53, 1931.
- MILLIKAN, G. and POINDEXTER, C. A. Mucocele of appendix with globoid body formation. *Am. J. Path.*, 1: 397-402, 1925.
- MONTGOMERY, J. G. and JOHNSON, E. T. *J. Missouri M. A.*, 28: 215-220, 1931.
- MONOD, R. C. and VUILLIEME. *J. de Chir.*, 38: 38-47, 1931.
- MORELLI, M. *Pathologica*, 25: 80-87, 1933.
- MORGAN, J. O. Mucocele of the appendix. *J. A. M. A.*, 7: 14-15, 1937.
- MORROUD, P. and IMBERT, R. *Bull. et Mém. Soc. Nat. de Chir.*, 58: 732, 1932.
- MOSCHCOWITZ, E. *Ann. Surg.*, 63: 697, 1916.
- MUIR, J. B. *Lancet*, 1: 131, 1931.
- MUNDL, T. Ueber veränderungen der Muskelwand des Wurmfortsatzes in Pathologischen Anatomische Arbeiten: Herren Geh. Medicinalrath Dr. Johannes Orth. zur Fuer Seines 24 Jährigen Professor Jubiläums, Berlin, 1903, A. Herschwald.
- MURESAN, I. and PIREE, F. *Med. Klin.*, 29: 1445-1446, 1933.
- MUSLOW, F. W. Mucocele of the appendix with diverticulum and invagination into cecum. *Tr. Chicago Path. Soc.*, 13: 434-435, 1933.
- MUSLOW, F. W. *Arch. Surg.*, 24: 923, 1932.

- MYERS, W. H. Mucocele of the appendix with report of a case. *Illinois M. J.*, 47: 386, 1925.
- NAESLUND, JOHN. Zur Kenntnis des Pseudomyxoma Peritonaei e Processu Vermiformi. *Upsala Läkarof. Förb.*, xxiv, 1-219, 1928.
- NASH, W. G. *Brit. M. J.*, 2: 595, 1919.
- NAZZ, V. *Arch. f. Gynäk.*, 153: 350-358, 1933.
- NEUMANN, A. Pseudomyxoma Peritonei ex Processu Vermiformi. *Berlin klin. Wcbnschr.*, 1: 15, 1909.
- NORMENT, WM. N. Tumors of the appendix. *Surg., Gynec. & Obst.*, 55: 590, 1932.
- OBENDORFER, S. Handbuch der Speziellen Pathologischen Anatomie und Histologie, F. Henke und O. Lubarsch. Berlin, 1929. Verlog von Julius Springer.
- OGLIVIE, H. H., J. A. M. A., 64: 657, 1915.
- OLHAUSEN, R. Ueber Metastasenbildung Bei Gutartigen Ovarialkystomen. *Ztschr. f. Geburtsb. u. Gynäk.*, xi, 238-245, 1884.
- OLSON, O. A. *Minnesota med.*, 19: 297, 1936.
- PACK, G. I. and SCHARNAGEL, I. *Am. J. Surg.*, 58: 369, 1928.
- PETERSON, R. F. *Northwest Med.*, 33: 328-330, 1934.
- PHEMISTER, D. N. Pseudomucinous cyst of the appendix: its relation to pseudomyxoma peritonei. *J. A. M. A.*, lxiv, 1834-1836, 1915.
- PITTS, H. H. and GEE, E. A. Pseudomyxoma peritonei originating in a mucocele of the appendix. *Canad. M. A. J.*, 28: 226-228, 1933.
- PORTER, H. K. *Australia M. J.*, 2: 252, 1924.
- PUGH, DAVID G. A roentgenologic aspect of pseudomyxoma peritonei. *Radiology*, 39: 320-322, 1942.
- QUATROCCHI, A. *Policlinico* 41: 1169-1172, 1934.
- RANZI, E. Mucoceles of the appendix. *Wien. med. Wcbnschr.*, 76: 643-645, 1926.
- RATHE, E. Pseudomyxoma peritonei ex Processu Vermiformi. *Berlin Klin. Wcbnschr. Monatschr. f. Geburtsb. u. Gynäk.*, 37: 322, 1913.
- RIBBERT. Beitraege zur Normalen und Pathologischen Anatomie des Wurmfortsatzes. *Arch. f. patb. Anat.*, cxxxii, 66-90, 1893.
- RIES, E. Pseudomyxoma peritonei. *Surg., Gynec. & Obst.*, 39: 569, 1924.
- ROEVEKAMP. *Fortschr. a. d. Geb. D. Roentgenstrahlen*, 26: 298, 1927.
- ROKITANSKY. Lehrbuch der Pathologischen Anatomie. 288, 1842.
- ROYSTER, H. A. Appendicitis, Surgical Monographs. New York, 1927. Appleton.
- SARFF, O. E. *Minnesota Med.*, 19: 739, 1936.
- SEELIG, M. F. Pseudomyxoma peritonaei in male subjects. *Surg., Gynec. & Obst.*, xxx, 570, 1920.
- SELINGER, J. *Ann. Surg.*, 89: 276-281, 1929.
- SIMARD, L. C. *Canad. M. A. J.*, 33: 518, 1935.
- SIMON, STEFAN. *Deutsche Ztschr. f. Chir.*, 187: 1-14, 1924.
- SIMON, W. V. *Klin. Wcbnschr.*, 48: 1501, 1911.
- SQUIRES, C. D. Mucocele of the appendix. *New York State M. J.*, 31: 285-286, 1931.
- STENGEL, ALFRED. Mucocele of the appendix. *J. A. M. A.*, 46: 495, 1906.
- STEWART, J. D. *New England J. Med.*, 203: 1288, 1930.
- STOUT, A. P. *Arch. Surg.*, 6: 793, 1923.
- SUSSI, L. *Policlinico*, 37: 568-576, 1930.
- TARANTOLA, R. Myxoglobulosis of the vermiform appendix. *Pathologica*, 25: 316, 1933.
- TERRY, W. I. and MUGLER, F. R. Diverticula of the jejunum. *Arch. Surg.*, 2: 347, 1921.
- THOMAS, A. O'D. *Brit. M. J.*, 1: 680, 1923.
- TOPPING, M. HAWKINS. Carcinoma with mucocele of appendix. *Calif. & West. Med.*, 29: 186, 187, 1928.
- TROTTER, W. Peritoneal pseudomyxoma originating from the vermiform appendix. *Brit. M. J.*, 1, 687-689, 1910.
- VAN ALSTINE, G. S. *Illinois M. J.*, 49: 469-473, 1926.
- VAN HOOK, W. *Medicine*, 2: 177-189, 1896.
- VIRCHOW. Die Krankhaften Geschwülste. Berlin, A. Hirschwald, 1: 250, 1863-1867.
- VORHAUS, M. G. Recognition of some of the less common diseases. *J. A. M. A.*, 94: 165, 1930.
- WALMSLEY, T. J. *Anat.*, 64: 47, 1929.
- WANGENSTEEN, O. H. and BOWERS, W. F. *Arch. Surg.*, 34: 496-526, 1937.
- WANGENSTEEN, O. H., BURGE, R. E., DENNIS, C. and RITCHIE, W. P. Studies in the etiology of acute appendicitis. The significance of the structure and function of the vermiform appendix in the genesis of appendicitis. A preliminary report. *Ann. Surg.*, 106: 910-942, 1937.
- WANGENSTEEN, O. H. and DENNIS, C. Experimental proof of the obstructive origin of appendicitis in man. *Ann. Surg.*, 110: 629-647, 1939.
- WANGENSTEEN, O. H. and DENNIS, C. The production of experimental acute appendicitis (with rupture) in higher apes by luminal obstruction. *Surg., Gynec. & Obst.*, 70: 799-806, 1940.
- WAUGH, T. R. and FINDLEY, D. Mucocele with peritoneal transplantation in adenocarcinoma of the appendix. *Am. J. Surg.*, 37: 518-525, 1937.
- WEAVER, C. H. Mucocele of appendix with pseudomucinous degeneration. *Am. J. Surg.*, 36: 523-526, 1937.
- WEAVER, D. D. Mucocele of the appendix. *Calif. & West. Med.*, 28: 500, 1928.
- WEGENER. *Zentralbl. f. Chir.*, 52: 971-975, 1925.
- WELLS, A. O. *Brit. J. Surg.*, 24: 766-772, 1937.
- WERTH. Klinische und Anatomische Untersuchungen zur Lehre von den Bauchgeschwulsten und der Laparotomie II Pseudomyxoma Peritonei. *Arch. f. Gynäk.*, 24: 100-118, 1884.
- WHIPHAM, T. R. C. *Lancet*, 1: 319-321, 1901.
- WILKIE, O. P. D. *Brit. J. Surg.*, 7: 392, 1921.
- WILLCUTTS, CAPT. M.D. and COMMANDER KUNKEL, E. P., U. S. Naval Med. Bull., 2: 418-421, 1942.
- WILMOTH, C. L. Mucocele of the appendix. *Am. J. Surg.*, 34: 383, 384, 1936.
- WOODRUFF, R. and McDONALD, J. R. Benign and malignant tumors of the appendix. *Surg., Gynec. & Obst.*, 71: 750-755, 1940.



# LATERAL OSTEOTOMY

## ANATOMICAL CONSIDERATIONS

CONRAD K. GALE, M.D.

Visiting Surgeon, Otorhinolaryngology, New York City Cancer Institute

NEW YORK, NEW YORK

THROUGH the courtesy of the Museum of Natural History 1,000 of its very large collection of skulls were examined. They present the anatomical basis of this paper. The skulls examined included specimens of all peoples extant today, and extended backward to earliest civilization. Included in the specimens studied were the early Egyptians, Romans, Biblical peoples, prehistoric Indians of both North and South America, peoples of the Orient and the South Pacific, Esquimaux, etc.

The purpose of this paper is threefold: (1) To describe, we believe for the first time, the site of a groove located on the frontal process of the maxilla. We, of the Fomon group in New York have long been using this groove as an aid, and guide in the practical matters of operative technic. It is, therefore, of more than just academic interest. (2) To stress the surgical importance of this groove. It is the guide for the correct anatomical selection of the lateral osteotomy line in plastic reconstructive surgery. It is well known that the lateral osteotomy not done anatomically correct will leave a ridge of bone *in situ* which on healing causes an ugly facial disfigurement. (3) To present other points of anatomical interest having a bearing on the lateral osteotomy.

The aforementioned groove is present to a greater or lesser degree in all skulls. At times its presence is barely indicated on the surface of the bone, at other times it is deep and definite. While its length, depth, and width are variable, its direction is quite constant in all the skulls studied. To determine its direction we first take point "A," which lies on the suture line between

the two nasal bones, and approximately 2 mm. caudal to the root of the nose. (Fig. 1.) Our second point "c" lies about midway between the margin of the pyriform aperture closest to the infra-orbital foramen, and the foramen itself. A line joining points A and c shows the direction of the groove. The actual groove does not extend the entire length of this line since it usually does not extend onto the nasal bones themselves. It terminates at point "b" on the maxillary bone so that the groove proper is the line bc.) If an attempt is made to mark this line with ink on the surface of the skull, it will be found necessary to draw the line slightly arched upward to compensate for the convex surface of the bone. It is precisely this convexity of the surface of the bone which leads to mechanical difficulties in the actual sawing processes, unless it is recognized and compensated for by a rocking or see-saw manipulation of the saw. We made several hundred measurements to determine the average angle of this arc, but the results were very inconclusive and of no practical value.

There are no people either among the ancients or moderns, whose skulls as a rule showed exceptionally developed grooves. It was thought people with high dorsal nasal projections would have deep grooves, but this also is not true. We found that prehistoric Indians of Arizona and New Mexico, whose dorsal nasal projection was not marked, often had deep, wide grooves. In the Flathead Indians, and surprisingly in the Chinooks of Oregon deep grooves are common. The same is true of the Chinese, Esquimaux, Polynesian, and Negroid peoples

in whose skulls we expected to find very faint, if any, grooves. On the other hand, the ancient Greeks, Romans, and Near

for the lateral osteotomy had been prepared, it would only be necessary to feel the groove with the blade of the saw to

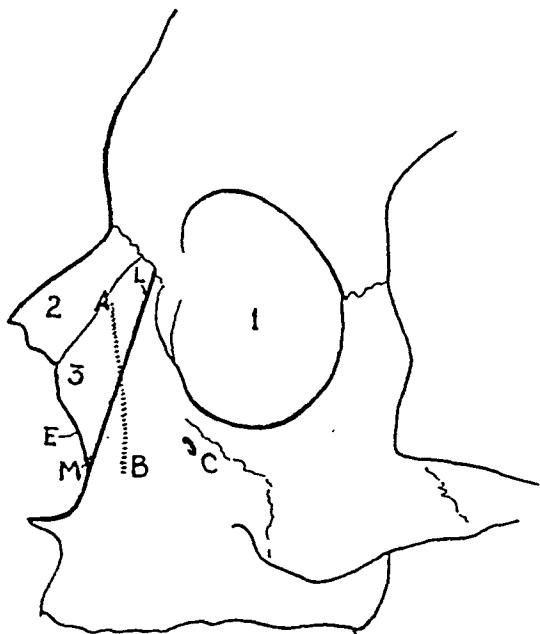


FIG. 1. AB, groove; C, infra-orbital canal; 1, orbit; 2, nasal bone; 3, maxilla frontal process; LM, ideal osteotomy line; E, margin pyriform aperture.

East people, whose aquiline nasal features led us to expect the presence of deep grooves, had at times only the faintest indication of their presence.

The groove averages about one and one-quarter inches in length. It is never identical on both sides of the skull or in any two skulls. The direction as already noted is always constant with only slight variations. The depth, width, and sharpness of the groove is variable. Most frequently the groove is widest, and deepest in its middle third. Rarely does the groove extend through the masomaxillary suture onto the nasal bone, but usually merges imperceptibly with the bone of the maxilla about one-eighth inch below the suture line. Caudally the groove also merges imperceptibly into the surrounding bone. It will be noted that the groove does not contact the margin of the pyriform aperture at any point. This is most important to remember.

The practical value of the groove appeared to be in the fact that once the bed

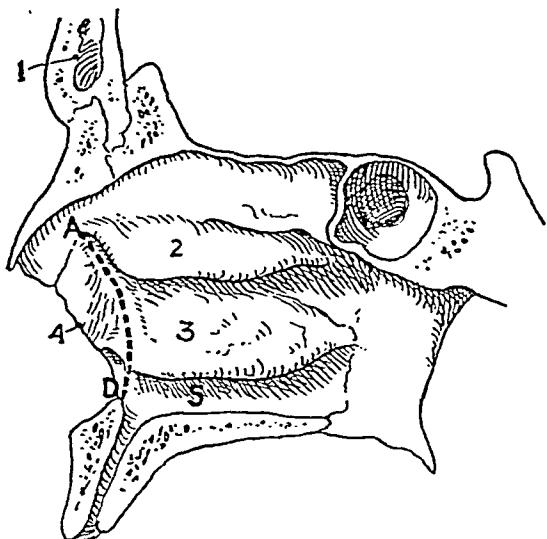


FIG. 2. Sagittal section of nose. 1, frontal sinus; 2, middle turbinate; 3, inferior turbinate; 4, margin pyriform aperture; 5, inferior meatus; AD, ridge following internal course of ideal osteotomy line.

have a fixed, anatomical landmark for purposes of orientation. This has been found of practical value in those instances in which it is possible to feel the grooves. In many instances where, for example, the lateral osteotomy is too small, or the groove is too indefinite and so cannot be felt, the knowledge of the anatomy of this region occasioned by a comparative study of the groove is a sufficient basis for an accurate lateral osteotomy.

The importance of the groove lies in its middle third, the depression of which can usually be felt with the saw and so establishes the most important middle third of both the osteotomy sawing line and the height of the convexity of the surface of the maxilla. This middle third of the groove always lies directly anterior to and above what we believe to be the ideal lateral osteotomy line.

This ideal osteotomy line can be seen as a thickened ridge of bone on the inner surface of the frontal process of the maxilla when a skull is held up to the light and viewed from the inside of the nasal chamber. This line is a ridge which can be

felt with the finger. It is triangular in shape with a blunt apex. The thin bone at the anterior margin of this ridge follows the line of the ideal osteotomy cut. This can easily be shown by holding any skull up to the light and tracing in ink on the outside of the skull the anterior margin of this ridge. Viewed from the interior of the nose against the light, the silhouette of this thickened ridge is in sharp contrast to the thin bone bordering it on either side. This ridge is continuous at its origin with the insertion of the anterior tip of the middle turbinate into the maxilla. (Fig. 2A). It then runs (B) obliquely downward and anteriorly to pass behind the junction of the anterior fifth with the posterior four-fifths of the inferior turbinate (c). Below the inferior turbinate the ridge again appears in the lateral wall of the inferior meatus (D). It then continues in its downward path to merge into the sharp margin of the pyriform aperture (E). This line drawn on the outside of the skull will always coincide with the middle third of the groove, but the drawing of this line follows the thin bone at the anterior margin of the thick ridge. Now it will be seen that the upper third of the ideal osteotomy line lies somewhat lateral to the groove while the lower third of this ideal line, since it cuts through the margin of the pyriform aperture, must lie medial to the lower third of the groove. In Figure LM shows the position of the ideal osteotomy line drawn on the outside of the skull and its relationship to the groove.

Thus anatomically the middle third of the groove acts as a fixed point for the lateral osteotomy. Once having established this point, the two variable points become the two ends of the saw and their direction

depends on whether we wish more or less narrowing of the nose. Thus, the closer to the inner canthus of the eye the tip of the saw is brought, the greater will be the narrowing effect, while the closer it approaches the glabella the less the narrowing. The heel of the saw can be placed in contact with the margin of the pyriform aperture at its lowest level. This positioning can be felt against the aperture margin. However, it is not necessary that the lateral osteotomy cut through the pyriform aperture for a successful narrowing. The lowermost part of the osteotomy line can be more than an eighth of an inch away from the pyriform margin should this be the desired sawing line. A successful narrowing in fracturing is always obtained because the fracturing will extend the lower end of the sawing line to the margin of the pyriform aperture.

There is only one more point to consider. We wish to make the lateral osteotomy so that it will correspond to the thin anterior margin of the thick internal ridge. If this is not done, the sawing will be made more difficult by having to saw through thick rather than through thin bone. To accomplish this purpose it is necessary to hold the saw not at the usual angle of 90 degrees to the surface being cut but at an angle of 120 degrees. In practice the flat of the saw is held almost flush to the plane of the body of the maxilla.

#### SUMMARY

1. A constant anatomical groove in the frontal process of the maxilla has been described.

2. The practical application of this groove to the lateral osteotomy has been shown.



# COTTON SUTURE MATERIAL\*

## IMPORTANCE OF SURGICAL PRINCIPLES

LIEUT. COLONEL BUFORD WORD, M.C. AND CAPTAIN CLAYTON E. BROCK, M.C.  
CAMP SHELBY, MISSISSIPPI

THE problems of wound healing necessarily receive additional attention in time of war. Improvements in technic have been, in a large measure, slowly evolved through knowledge gained in the care of war wounds. However, it is often questionable just how much progress has been made since the days of Ambrose Paré who, in the sixteenth century, appreciated the difference in healing between the gently cleansed wound and the wound cauterized with boiling oil. All too few are the surgeons who practice and teach the important surgical principles of wound healing. Rare—at least uncommon—are the fortunate who are painstakingly indoctrinated with those minute detailed principles of surgical technic which make excellent wound healing an expected result. Often the busy young surgeon has the knowledge but lacks the patience and practical wisdom necessary for its proper application. Too many are those who have been surgically reared on a "routine closure" who have been able to "get by" with careless and unjustifiable methods because of the remarkable ability of living tissue to withstand the trauma of the surgical team. Samuel L. Ledbetter, Jr.<sup>1</sup> has called attention to the fact that, "Wound healing is a natural cellular growth, and if the wound is not handicapped by necrotic tissue, foreign bodies, strangulating ligatures, blood clots, etc., it will heal spontaneously." We appreciate that the importance of surgical principles has been well presented in several fine articles during the past decade. Nevertheless, we believe, as Mont R. Reid<sup>2</sup> has pointed out, "—that a thorough knowledge of the principles of wound healing and its daily thoughtful

application is of the most fundamental importance in the practice of surgery."

It is our belief that much of the recent literature has wrongly emphasized the advantage of one type of suture material over another without regard to the importance of gentleness in handling tissues, well placed incisions made with sharp blades, careful gentle sponging, adequate length of the incision necessitating only moderate retraction, identification of anatomical structures, meticulous hemostasis, use of small instruments and needles, and the proved fact that fine, non-absorbable sutures cause minimal tissue reaction.

The fundamental surgical principles formulated by Halsted<sup>3</sup> and repeatedly emphasized by Sumner L. Koch,<sup>4,5,6</sup> Michael L. Mason,<sup>7,8,9</sup> Allen O. Whipple,<sup>10</sup> Mont R. Reid,<sup>2,11,12</sup> and Samuel L. Ledbetter<sup>1</sup> must be rigidly adhered to if one expects to obtain best results with cotton suture material. To have been well trained in these sound surgical principles and possess the surgical philosophy to practice them are priceless possessions. All failures in clean wound healing should be considered a direct result of poor surgical technic and should be made a matter for serious, honest investigation. Each wound, surgical or accidental, offers an opportunity to improve our knowledge of wound repair.

In February, 1942, Dr. Robert Day, resident in surgery on Dr. Alton Ochsner's service at Charity Hospital, New Orleans, Louisiana, visited our operating room, and during his visit reminded us of the many virtues of cotton thread as a suture material. Ever striving to repair our wounds in as ideal a manner as possible, we familiarized ourselves with the literature on the

\* From the Surgical Service of Lieut. Colonel William C. Reed, M.C., Station Hospital, Camp Shelby, Mississippi.

use of cotton as a suture material and performed the first operation in this hospital using all cotton suture technic in March, 1942. Since that date we have used all cotton sutures in more than two hundred major operations with very gratifying results. However, the improvement noted in the closure of wounds in this series is attributed to an improved surgical technic on the part of the surgeons and is not due entirely to the thread used. The greatest advantage we have found in using cotton is its delicacy when compared with catgut, thus serving as a constant reminder that the operator should be more gentle in handling the suture as well as the tissues. When cotton is placed in the tissues correctly, the wounds heal faster, with minimal reaction, and with less discomfort to the patient. Our experience with cotton has taught us that the size of the suture and attention to minute details in placing the suture in the tissue is more important than the type of suture used.

Following the exhaustive experimental studies of William H. Meade and Alton Ochsner,<sup>13</sup> frequent reports have been published on the subject. William H. Meade and Carroll H. Long,<sup>14</sup> Phil Thorek,<sup>15,16</sup> C. A. Pannett,<sup>17</sup> S. Arthur Localio and J. William Hinton,<sup>19</sup> John E. Cannaday,<sup>19</sup> and E. A. Nixon<sup>20</sup> have emphasized the importance of the Halsted technic but none has suggested that the improvement noted in wound healing might be due, in the greater part, to a refined surgical technic. In support of our contention that a refined technic is more important than the type of suture used, the following instance is cited.

One of the authors, prior to entering Military Service, was well trained in the use of fine suture material, gentle handling of tissue, ligation of vessels with minimum surrounding tissue, meticulous hemostasis, and the use of interrupted sutures; the other's interest was largely gynecology, and a great many of his surgical principles were formulated while removing large fibroids with large sutures and taking large

bites of tissue with large needles. On occasion after entering the Service we would do a bilateral hernia together, using identical suture material. On the cases we did together, any time during the postoperative period one could stand at the foot of the bed with the patient's dressings removed and tell at a glance the surgeon responsible for each wound. After switching to cotton, the technic of handling the tissues and placing the sutures was so improved by one of us that it was possible to stand at the foot of the bed in the same type of case and be unable to distinguish any difference in the operative wounds. The wounds of the plastic surgeon were only slightly improved; the wounds of the pelvic surgeon were greatly improved. There is little doubt that if we had used any other fine suture material as carefully as we used cotton in the cases herein reported, the results in wound healing would have been better than we were obtaining before using cotton.

Repeated emphasis on surgical principles and a refined surgical technic has included careful attention to every detail of the entire surgical procedure. No less important are adequate cleansing of the hands and forearms of the surgical team, appropriate masking of the face, including nose as well as mouth, proper preoperative preparation of the patient, and gentle, thorough preparation of the operative site, remembering also, "The good workman needs good tools." The site of incision is selected after studying the flexion creases in the area, keeping in mind the surgical pathology of the disease for which the patient is being operated, as well as the blood and nerve supply of the area. Each operation is treated as an individual problem, and an honest effort is made to keep from doing routine ritualistic procedures; a satisfactory explanation justifies each step.

The incision is made with a sharp scalpel and skin bleeders are clamped with small hemostats. Great care is exercised to pick up only the vessels, including a minimum

of surrounding tissue. The large bleeders in the subcutaneous tissue are clamped before dividing, when possible, and the portion of the vessel distal to the ligature is excised. As sponging is needed, the wound is gently blotted—never scrubbed. The vessels are ligated with fine plain cotton as the layers of the abdominal wall are traversed. Control of hemorrhage is accurately and carefully done, appreciating the difference between "ideal"<sup>2</sup> and complete hemostasis.

Gentleness in the handling of delicate tissue is the most important single part of the surgical technic. The gentle surgeon will not use large instruments, large sutures, ligate large portions of tissue to become necrotic and perhaps infected, tie sutures and ligatures too tightly, traumatically retract tissue or forcibly "scrub-sponge" a wound. Instead careful attention will be given to every detail of the operation. The surgeon who is at all times acutely conscious of the importance of doing no harm and adding no additional burden to the tissues will unconsciously follow the fundamental principles of good surgery, irrespective of the suture he employs.

Edward L. Howes and Samuel C. Harvey,<sup>21</sup> Charles H. Lupton,<sup>22</sup> and many others have proved that fine suture material causes minimal tissue reaction. The important additional advantages of cotton are its greater strength when moist, and minimum tendency of knots to slip because of the high coefficient of friction, allowing cutting close to the knot, and thereby reducing to a minimum the amount of foreign body left in the wound. Fine suture and ligature material will not permit traumatic mass ligation and strangulation of tissue even if the surgeon forgets. Multiple, well spaced, approximating and not strangulating sutures are made imperative. The importance of the careful placing of sutures and proper reapproximation of divided structures has been dramatically demonstrated by Jean Stevenson and Mont R. Reid<sup>23</sup> in their experiment in

which the abdominal wounds of dogs were sutured by the traumatic andatraumatic method. Both wounds were reopened in five days; in one dog the wound was healing with minimal reaction; in the other dog many of the sutures had sloughed out following pressure necrosis. The uselessness of using a suture stronger than the tissue it coaptates is a well established but often disregarded fact. We have no "suture routine" such as No. 24 for this layer and No. 60 for another in certain operations. Instead, each operation is considered an individual one, the finest suture practicable being used. The suture selected for each layer is about equal in strength to the tissues it holds in apposition. Sizes 150 to 30 are always available, and the size selected depends upon the type of operation and the physical development of the individual;—greater strength in the anatomical structures severed requires greater strength in the suture used to reapproximate them. As Reid<sup>2</sup> advised, "Study each wound and then do what you think best," can be practiced in selecting the size of material to use in closing a wound with cotton.

The cases we are including in this series have been consecutive, unselected, and include perforated peptic ulcers, ruptured appendices, branchial cleft cysts, wound disruptions, thyroidectomies, thyroglossal duct cysts, cholecystectomies, hemorrhoidectomies, mastectomies, herniorrhaphies of all descriptions, and many types of accidental wounds. In all cases of perforated peptic ulcer, the wounds healed by primary union. In five cases of appendicitis with rupture the wounds healed by primary union in three cases and infection developed in two. In one of these infected cases a sinus developed. In 198 clean cases three of the wounds became infected, two of which progressed to sinus formation, making a total of three wounds in the entire series that developed a sinus, a phenomenon as yet unreported by any of the authorities employing cotton suture material. In fact, cotton, due to its structure, is supposed to reduce to a minimum the possibility of

sinus formation. Cotton, being a vegetable fiber, has a natural tendency to twist. This characteristic of the material eliminates interstices between its fibers and prevents granulation tissue from growing into the suture, a factor which has been advanced as the cause of sinus formation when silk is used. Although two of the three clean cases to develop wound infection were operated upon by other members of the staff, the results were so unusual, a brief description of all three cases is indicated. The fourth case report is that of the contaminated case in which a sinus was formed.

#### CASE REPORTS

**CASE I.** F. A., a white male, age twenty-four, Hospital Register No. 24,630, was admitted to the hospital April 1, 1942. Operation for left inguinal hernia was performed on April 6, 1942. The operating surgeon had not familiarized himself with the technic of using cotton and in a hurry to complete the operation closed one layer with cotton and the next with catgut. Cotton was also used as a running suture.

The wound became infected, and on April 13th, the sixth postoperative day, 120 cc. of purulent material was drained from the wound. The wound drained profusely for two weeks, then gradually closed.

The patient was discharged May 22nd. He was readmitted to the hospital on July 20th and gave a history of, "Wound draining continuously since operation." Examination of the patient showed a sinus in the center of the operative scar.

On August 4th two white cotton sutures were removed from the bottom of the sinus and the wound promptly healed, approximately four months after operation.

**CASE II.** C. G. L., a white male, age twenty-nine, Hospital Register No. 34,057, was admitted to the hospital July 8, 1942. Operation for left inguinal hernia using all cotton suture technic was performed on July 13th. The repair was done through a Babcock cutaneous incision, ligating the sac with No. 30 plain cotton suture and transplanting the stump beneath the fibers of the transversalis and internal oblique muscles. The inguinal canal was obliterated by coaptating the conjoined tendon and inguinal ligament with interrupted sutures of No. 30 white cotton. The cord was not

transplanted. The operation lasted one hour and ten minutes.

On July 19th the wound became suppurative and purulent material obtained from the wound showed *Staphlococcus albus*. Drainage continued until October 14, 1942. On this date the entire wound was excised, including a sinus tract which extended down to the transversalis fascia, at the bottom of which were two No. 30 cotton sutures. The sutures were removed together with all chronic granulation tissue. This second operation was done by one of our colleagues, using catgut to repair the wound after thorough irrigation with a suspension of microcrystals of sulfathiazole.

The wound became indurated on the third postoperative day and purulent material escaped on the tenth day. The drainage was profuse for three weeks and then gradually ceased, allowing the wound to close.

The soldier was discharged to duty on December 16, 1942, following a hospital stay of more than five months because of the primary infection.

**CASE III.** T. J. B., a white male, age twenty-five, Hospital Register No. 40,916, was admitted to the hospital and appendectomy performed on October 11, 1942, through a Rockey muscle splitting incision. The individual was obese and the appendix was located with difficulty. It was eight inches long, bound down with adhesions, and located retroceccally. Although the appendix was removed intact, the entire serosal layer was stripped off during the procedure. The spinal anesthetic wore off during the operation and had to be supplemented with inhalation anesthesia, prolonging the operation considerably. The operating time was one hour and fifty-five minutes.

On the tenth postoperative day the wound developed infection and drained purulent material which, on culture, showed *Staphlococcus albus*. The wound healed spontaneously and the patient was discharged to duty on the thirtieth postoperative day.

Although no gross contamination occurred in this case, the surgical technic was imperfect, and when infection developed, the operator was more chagrined than surprised.

**CASE IV.** A. W., a colored male, age twenty-nine, Hospital Register No. 48,213, was admitted to the hospital December 22, 1942. He was operated upon for ruptured appendix on the day of admission. Frank pus was encountered in the peritoneal cavity. The appendix

was removed and 15 Gm. of sulfathiazole powder was placed in the abdominal cavity. Following closure of the peritoneum, the wound was irrigated with copious amounts of saline. Because of the obesity of the individual, a small drain was placed beneath the fascia of the external oblique muscle.

Following removal of the drain on the fourth postoperative day, purulent material flowed from the wound for several days and then gradually diminished except for one small area in the center which refused to heal. The sinus was probed with a crochet needle but no suture could be found. On February 15, 1943, the fifty-fourth postoperative day, the wound was opened and the sinus tract excised. The tract extended a distance of two and one-half to three inches to the deep layer of the superficial fascia, at the bottom of which was a small cotton suture. The sinus tract was lined with typical gelatinous granulation tissue. The remainder of the wound was firm and well healed.

TABLE I

Contaminated Cases	Primary Union	Wound Infection	Sinus Formation
22	19	3	1
Clean Cases	Primary Union	Wound Infection	Sinus Formation
198	195	3	2

The infections which developed in our clean cases were a direct result of a violation of the principles of surgical technic discussed in this paper. Cotton was mixed with catgut and also employed as a running suture in the first case. In the second case, although no gross violation was visible, we are convinced that a break in technic occurred—perhaps improper preparation of the hands and forearms of the surgical team, or maybe a needle puncture of a gloved hand participating in the operation. The technic in the third case was admittedly very poor in many respects. The incision was cone shaped through an obese abdomen, and necessitated traumatic retraction. In removal the appendix was stripped from

within its serosal layer; further, the operating time was unnecessarily prolonged because of the necessity of supplementing the spinal anesthetic. For a wound so treated to heal with minimum infection is the best that any surgeon could expect. Had such a wound healed by primary union, our study would serve no useful purpose. "The patient's best defense against infection lies in the perfection of the operator's technique."<sup>24</sup>

No mention has been made of the influence of the nutritional state of the patient on wound healing. We have operated on no patients in the extremes of life. All have been young, vigorous, healthy, military patients whose diets have been deficient in none of the elements which promote good wound healing. Further, all elective cases were x-rayed prior to operation to exclude chronic pulmonary disease and examined carefully to detect any other systemic disease contraindicating operation.

One striking feature we have noted in our cases is the low temperature on the first and second postoperative days. In medical school we were taught that this postoperative elevation was a natural phenomenon and was called "fibrin ferment fever." The postoperative febrile reaction has exceeded 99.5°F. in only a few instances. One other feature discovered during this study was that the patients were noticeably free of pain following operation, although no study has been made to determine if our series had less hypodermics of morphine following operation than a like number of patients whose wounds were sutured with catgut. It has been called to our attention, however, on more than one occasion, that an appendectomized patient required no hypodermics during the entire postoperative course.

Cotton has been suggested as an ideal war time suture material by Meade and Ochsner,<sup>25</sup> Thorek,<sup>16</sup> and Pannett.<sup>17</sup> However, it should be pointed out that a meticulous surgical technic, so necessary for success with cotton, is more time

consuming. The operating time has been increased in our series 15 to 20 per cent, a factor that requires serious consideration when operations are contemplated under battle conditions.

#### SUMMARY

The successful use of cotton suture material will depend upon strict attention to fundamental surgical principles. The use of a minimum of foreign material shares importance with gentleness in handling delicate tissues, meticulous hemostasis, accurate reapposition of divided structures without tension, and patient attention to technical details. When employed in compliance with these principles, cotton is an ideal suture material.

#### REFERENCES

1. LEDBETTER, S. L., JR. Wound healing and the closure of wounds. *Alabama M. J.*, August, 1942.
2. REID, MONT R. Some considerations of the problems of wound healing. *New England J. Med.*, 215: 753, 1936.
3. HALSTED, W. S. The employment of fine silk in preference to catgut and the advantages of transfixing tissue and vessels in controlling hemorrhages. *J. A. M. A.*, 60: 1119, 1913.
4. KOCH, S. L. The primary treatment of wounds. *Minnesota Med.*, 24: 747, 1941.
5. KOCH, S. L. The immediate treatment of compound injuries. *Illinois M. J.* 67: 40-45, 1935.
6. KOCH, S. L. Injuries of the parietes and extremities. *Surg., Gynec. & Obst.*, 76: 1, 1943.
7. MASON, MICHAEL L. Wound healing. *Surg., Gynec. & Obst.*, 69: 303, 1939.
8. MASON, MICHAEL L. Wound healing. *Illinois M. J.*, 78: 523, 1940.

9. MASON, MICHAEL L. The immediate treatment of compound injuries. *Illinois M. J.*, 72: 249, 1937.
10. WHIPPLE, ALLEN O. The essential principles in clean wound healing. *Surg., Gynec. & Obst.*, 70: 257, 1940.
11. REID, MONT R. and CARTER, NOLAND B. The treatment of fresh traumatic wounds. *Ann. Surg.*, 114: 4, 1941.
12. REID, MONT R. Complicated wounds. *Internat. Abstr. Surg.*, 68: 552, 1939.
13. MEADE, WILLIAM H. and OCHSNER, ALTON: The relative value of catgut, silk, linen, and cotton as suture materials. *Surgery*, 7: 485, 1940.
14. MEADE, WILLIAM H. and LONG, CARROLL H. The use of cotton as a suture material. *J. A. M. A.*, 117: 2140, 1941.
15. THOREK, PHIL. Experience with spool cotton as a suture material. *Am. J. Surg.*, 55: 118, 1942.
16. THOREK, PHIL, GRADMAN, RALPH and GLAESER, ALFRED. Additional experience with spool cotton as a suture material. *Am. J. Surg.*, 59: 68, 1942.
17. PANNETT, C. A. A plea for war time use of cotton ligatures. *Lancet*, 242: 755, 1942.
18. LOCALIO, S. ARTHUR and HINTON, J. WM. The choice and use of cotton for suture material. *Surg., Gynec. & Obst.*, 72: 615, 1941.
19. CANNADAY, JOHN E. Discussion of Dr. Perrin H. Long's paper, Sulfonamide compounds in the prevention and treatment of wound infection. *J. A. M. A.*, 121: 307, 1943.
20. NIXON, E. A. The three C's of surgical healing. *Northwest Med.*, 41: 129, 1942.
21. HOWES, E. L. and HARVEY, S. C. Tissue response to catgut absorption, silk and wound healing, correlation with tensile strength. *Internat. J. Med. & Surg.*, 43: 225, 1930.
22. LUPTON, CHARLES H. The principles of surgical technic with comparison of results obtained with fine silk, fine chromic catgut and large catgut (chromic and plain). *Am. J. Surg.*, 57: 122, 1942.
23. STEVENSON, JEAN and REID, MONT R. The treatment of traumatic wounds. *Am. J. Surg.*, 46: 442, 1939.
24. HOMANS. Quoted by Reid, Mont R.?
25. MEADE, WILLIAM H. and OCHSNER, ALTON. Spool cotton as suture material. *J. A. M. A.*, 113: 2230, 1939.



# PAIN IN THE SHOULDER AND UPPER EXTREMITY DUE TO SCALENUS ANTICUS SYNDROME

BERNARD JUDOVICH, M.D.,

WILLIAM BATES, M.D.

AND

WILLIAM DRAYTON, JR., M.D.

PHILADELPHIA, PENNSYLVANIA

**T**HE purpose of this paper is to discuss symptoms and signs which are associated with the scalenus anticus syndrome.

**Anatomy:** The anterior scalene muscle arises from the anterior portion of the transverse processes of the third, fourth, fifth and sixth cervical vertebrae. It courses almost directly downward to be inserted at the scalene tubercle on the upper inner surface of the first rib. It is situated behind the subclavian vein and in front of the subclavian artery. The subclavian artery thus lies within the acute angle formed by the scalenus anticus muscle and first rib. The subclavian vein lies in front of the muscle and in the space between the first rib and the clavicle.

The trunks of the brachial plexus and the cervical sympathetic chain lie behind the medial surface of the muscle. At each level from the third to the sixth cervical segment a branch is supplied to innervate the muscle.

Thus, conditions which cause spasm or hypertrophy of the anterior scalenus muscle may cause pain by irritating: (1) The subclavian artery, (2) the brachial plexus, (3) the subclavian vein, and (4) the cervical sympathetics, or the vascular sympathetic fibers. Any of these structures may be irritated singly or in combination, often producing a mixed and confusing picture of pain and tenderness in the upper extremity. Narrowing of the costoclavicular space may also produce symptoms of vascular compression.

## IRRITATION OF THE SUBCLAVIAN ARTERY

A spastic or hypertrophied scalenus muscle may narrow the acute angle formed

by the muscle and the first rib. Since the subclavian artery lies within this angle it may be compressed, producing severe pain in the upper extremity. The hand and fingers may be cooler than those of the unaffected side. Oscillometric readings of the brachial artery show a diminished excursion as compared to the non-painful side. The patient complains of a dull heavy arm as though a weight were placed upon it, or perhaps a severe cramp-like ache. Often there is an associated sensation of numbness and tingling. The strength of the hand clasp is usually weakened.

Infiltration of the scalenus muscle with 2 cc. of 2 per cent procaine is usually followed by complete relief of pain in one to three minutes. The power of the hand grip increases in strength as soon as the pain subsides. The heavy sensation disappears.

## CASE REPORT

A fifty-three year old male complained of severe pain in the left shoulder and arm, the duration of which was three years. The onset followed a fall. The arm ached and felt heavy. There were times when the fingers would tingle and feel numb, especially the thumb, forefinger and middle finger. The strength of gripping power in the left hand was definitely impaired. Maintained pressure against the scalenus anticus muscle about 1 inch above the clavicle increased the pain. Oscillometric readings recording the maximum pulsation, were as follows:

	Left	Right
Brachial artery.....	$3.5^{\circ}$	$7^{\circ}$
Radial artery.....	$1.5^{\circ}$	$5^{\circ}$

Thermocouple readings showed a  $3^{\circ}\text{F}$ . decrease in skin surface temperature of the left hand as compared to the right hand.

Repeated infiltrations of the scalenus anticus muscle with procaine solution (2 cc.) always gave immediate and complete relief of the symptoms. However, when the anesthesia wore off, the pain returned. Surgical section of the muscle was followed by relief of pain. There was no recurrence of symptoms.

#### IRRITATION OF THE BRACHIAL PLEXUS

In several patients we were able to demonstrate areas of segmental nerve tenderness which were associated with pain. These findings were combined with symptoms denoting compression of the brachial artery. Tenderness of the fourth, fifth and sixth cervical nerve distributions could be defined. Irritation of the fourth cervical nerve produces pain over the upper half of the scapular region, and in the anterior chest wall down as far as the fourth rib.

With involvement of the fifth cervical distribution, pain and tenderness were limited to the middle third of the upper arm.

The sixth cervical dermatome when affected produces pain down the arm to and including the thumb.

One patient, a twenty-six year old male, complained of severe pain in the upper anterior chest and upper scapular region. He also complained that his entire arm felt like a dead weight. The power of his grip was affected on the painful side. Pressure against the scalenus muscle increased the pain as well as the heavy sensation in his arm. A complete segment of tenderness was mapped out, covering the shoulder girdle and upper left chest. This is the distribution of the fourth cervical dermatome.

A diagnostic infiltration of 2 cc. of procaine into the muscle caused complete cessation of all pain within three minutes. The heavy sensation in the arm disappeared, and the gripping power of the hand was restored. The tenderness of the fourth cervical segment disappeared.

#### IRRITATION OF THE SUBCLAVIAN VEIN

The subclavian vein is not often affected by a tightened scalenus muscle. However, it may be caused by the muscle elevating

the first rib and producing a partial compression of the vein, by narrowing the costoclavicular space, or perhaps by pressure on an anomalous subclavian vein passing behind the scalene muscle. We have seen two such cases, confirmed by operative findings in which the subclavian vein was found to be dilated to one and one-half times its normal diameter on the lateral side of the first rib.

The symptoms of which these patients complained were much alike. Both had a neuralgic ache of the arm extending to all the fingers. One had an area of extreme soreness over the dorsal aspect of the wrist, which was sensitive to light pressure and was associated with a burning sensation. The other patient had a similar area involving the entire base of the thumb. Both patients complained of a sensation of fullness in the fingers and "felt as though their nails were being pulled."

Objectively there was a mild dilatation of veins. The fingers were thickened and there was enlargement and tenderness of the phalangeal joints, presenting a picture of arthritic changes. The grip was weak, and the fist could not be completely closed.

In both cases the *skin surface temperature was increased on the painful side*. Oscilometric readings were normal. Infiltration of the scalenus muscle gave immediate but temporary relief of the severe pain, but did not affect the hyperalgesic areas, nor did it improve the strength of the hand clasp.

The duration of symptoms was two years in one case and fifteen years in the other.

Relief of pain followed cutting of the muscles. However, weakness of the grip and persistence of the sore spots in the periphery did not clear up immediately.

In the case of two years' duration of pain it was three months before the patient wrote and stated that his hand was beginning to get back to normal.

The patient who had had her symptoms for fifteen years also obtained nearly complete relief of pain. A year later she stated that her arm and hand had not felt so

well in the entire fifteen-year period. Neither patient developed any acute symptoms following section of the muscle.

Both patients presented signs which could be interpreted as due to arthritic processes associated with neuralgic pain. These signs were undoubtedly due to passive congestion produced by compression of the subclavian vein over a long period of time. In spite of the marked improvement of symptoms in both patients, the fingers did not regain their normal appearance.

#### IRRITATION OF THE SYMPATHETIC NERVES

There was one patient in our series in whom pain and vasomotor instability of the upper extremities apparently were due to irritation of the sympathetic fibers by a spastic scalenus muscle.

A forty-six year old female had excruciating pain in the left shoulder, arm and hand for a period of three weeks. The thumb and forefinger felt numb and tingled. No anesthesia or hypesthesia was present.

Although this complaint was of three weeks' duration, there was a history dating back fifteen years, in which frequent attacks of vascular spasm, at least one or two a day, caused blanching of the fingers of both hands. She stated that her fingers became "snow white" during these attacks.

Palpation revealed marked tenderness and rigidity of both scalene muscles. Slight pressure against the muscle on the left side intensified the pain. Infiltration of the muscle with 2 cc. of 2 per cent procaine gave complete relief of pain in two minutes.

Two days later, while we were about to repeat the infiltration on the left side, the right middle finger started to blanch. In one minute the distal half of the finger was completely blanched. The right scalenus muscle was injected with procaine. In about two minutes the blanched area began to disappear slowly and at the end of four minutes its normal color was entirely restored. She stated that this was the first time that such an attack had lasted less than forty-five minutes. She also stated that it was the first time that the left fingers had failed to blanch, and that they had

not done so since the scalenus injection two days ago. There was no recurrence of the pain on the left side reported at the end of one month, and blanching of the fingers had considerably diminished.

Thus it will be seen that there is no distinct syndrome due to a tightened hypertrophied or otherwise irritated scalenus muscle. The symptoms are variable and depend upon which anatomical structures are affected. Although in our series of seventy-five cases most of the patients showed symptoms suggestive of arterial compression, there were many patients whose symptoms did not fit into the picture of scalenus anticus syndrome as it is commonly presented.

#### DIAGNOSTIC SIGNS

A reliable sign is the comparison of pressure effects upon the scalenus muscle of the non-painful side with that of the painful side. The head should be held backward and tilted away from the painful side so that palpation of the scalenus muscle will be facilitated. At the same time, the thumb, placed about an inch above the clavicle, forces the posterior border of the sternocleidomastoid muscle medially. Pressure upon the scalenus muscle of the non-painful side should be firm and maintained for a full minute. Comparison with the painful side is then made. In all cases, the tenderness is much greater on the affected side and the continued pressure intensifies the pain and distress.

A definite reduction of the oscillometric readings denotes marked compression of the subclavian artery. However, we believe that there may be mild compression of the subclavian artery which produces pain with no change in oscillometric readings. In our series a reduction of skin surface temperature of the hand and fingers accompanied a decreased oscillometric reading.

Forcing the head back and away from the affected side tightens the scalenus muscle and increases the pain.

Diminution of the power of the hand grip on the affected side is often found.

A diagnostic procaine infiltration of the scalenus anticus muscle is the most dependable indication of the presence or absence of this syndrome.

One problem is to explain why patients who present symptoms suggesting a scalenus anticus syndrome and who obtain relief by a diagnostic infiltration of procaine, fail to obtain relief of pain when the muscle is sectioned.

In reporting the diagnostic procaine test, some observers state that a Horner's syndrome frequently follows the injection. Although it is true that through the scalenus mechanism there may be irritation of the sympathetics, it is a secondary effect and infiltration of the muscle with procaine which results in a Horner's syndrome with relief of pain should not be considered evidence that the muscle is at fault. Anesthesia of the brachial plexus or its branches will also cause relief of pain even though the scalenus muscle is not at fault.

We believe the answer to this is an accurate technic of injection. One reason that a Horner's syndrome often accompanies infiltration of this muscle is that too great a quantity of procaine has been injected, so that the procaine does not remain limited to the confines of the muscle. Another is that the needle pierces the scalenus muscle or misses it entirely so that not only may the procaine affect the sympathetic chain, but it may cause peripheral anesthesia due to contact with branches of the brachial plexus.

We wish to stress that sympathetic or brachial plexus anesthesia will relieve pain whether or not a true scalenus anticus syndrome is present. Sympathetic or brachial plexus anesthesia does not take place when the procaine is limited to the muscle, nor does it occur after surgical section of the muscle.

Therefore, when a diagnostic infiltration of the muscle is followed by a Horner's syndrome, or by numbness in the shoulder,

arm, or hand, the test should be disregarded and repeated on another occasion.

#### TECHNIC OF INFILTRATION

Previously, we reported a technic of infiltrating the anterior scalenus muscle by means of a small hypodermic needle. The technic has been simplified to make certain that the procaine will be injected into and remain confined within the muscle.

The patient's head is brought over to a painful side to relax the sternocleidomastoid muscle. Just above the clavicle, the sternocleidomastoid muscle is pushed medially, at the same time forcing the fingers inward and downward. At this moment the head is pressed to the opposite side and retracted. This causes the scalenus muscle, which at this level is just behind the posterior border of the sternocleidomastoid muscle, to become palpable so that it may be straddled by two fingers. After locating and straddling the muscle the fingers are pushed down firmly causing the muscle to bulge between the fingers. A  $\frac{3}{8}$  inch hypo-needle is inserted between the fingers, directly into the belly of the muscle, 2 cc. of 2 per cent procaine are injected.

#### RESULTS FOLLOWING INFILTRATION

Complete relief of excruciating pain may take place within one minute following the injection. If no relief is obtained within three minutes, we regard the test as negative.

If the patient obtains immediate relief of pain under the conditions specified, and the pain returns in a half hour or more, it is still regarded as a positive test. Fifty per cent of patients with a scalenus anticus syndrome will obtain clinical relief of pain by repeated infiltration. This is a higher percentage than we had reported previously.

If three or four successive injections cause immediate relief indicating a positive test, and on each occasion the pain returns with its former severity, the muscle should be surgically sectioned.

Patients who show continued improvement with successive infiltrations should continue with this therapy. If progress becomes stationary and the amount of residual pain warrants it, the muscle should be cut.

#### SUMMARY

1. Symptoms and clinical signs have been discussed which are dependent upon disturbances of anatomical structures in the vicinity of the scalenus anticus muscle.

2. A new technic of infiltration of the scalenus anticus muscle has been presented.

#### REFERENCES

1. NAFFZIGER, H. C. and GRANT, W. T. Neuritis of the brachial plexus, mechanical in origin. *Surg., Gynec. & Obst.*, 67: 722, 1938.
2. OCHSNER, A., GAGE, M. and DEBAKEY, M. Scalenus anticus (Naffziger) syndrome. *Am. J. Surg.*, 3: 669-693, 1935.
3. GAGE, M. Scalenus anticus syndrome. *Surgery*, 5: 599-601, 1939.
4. KAPLAN, L. Shoulder pain. *Pennsylvania M. J.*, December, 1940.
5. KAPLAN, L. Relationship of scalenus anticus to shoulder pain. *Arch. Surg.*, April 1940.
6. JUDOVICH, B. D., and BATES, WM. The scalenus anticus syndrome. *J. Internat. Col. Surg.*, (Jan.-Feb.) pp. 26-32, 1942.
7. JUDOVICH, B. D. and BATES, WM. The scalenus anticus syndrome. *Am. J. Surg.*, 57: 523-524, 1942.



DRY gangrene occurs when the tissues are desiccated by gradual slowing of the blood-stream, and typically occurs as a result of arterial degeneration. The affected part becomes dry and wrinkled, discoloured from disintegration of haemoglobin, and greasy to the touch.

# Case Reports

## PRIMARY ADENOCARCINOMA OF THE JEJUNUM WITH INTUSSUSCEPTION\*

### CASE REPORT

JOHN B. O'DONOGHUE, M.D.,  
Attending Surgeon, Cook County Hospital

MANUEL E. LICHTENSTEIN, M.D.  
Associate Surgeon, Cook County Hospital

AND

MAURICE B. JACOBS, M.D.  
Associate Surgeon, Cook County Hospital  
CHICAGO, ILLINOIS

CARCINOMA of the jejunum, like carcinoma of the remainder of the small intestine while not a rare lesion is infrequently seen. An acute mechanical obstruction caused by an intussusception is uncommon since this complication of small intestinal tumors is most often encountered in benign lesions, its incidence from statistical reports being placed at 17 to 30 per cent; the frequency of intussusception in malignant tumors of the small intestine is given as less than 4 per cent.

The occurrence of a carcinoma of the jejunum in one of the youngest patients recorded in the literature of the past ten years complicated by intussusception makes this case interesting.

### CASE REPORT

I. S., a white male, aged twenty-four, was admitted to the Cook County Hospital December 28, 1940, (surgical service of Dr. John B. O'Donoghue) with complaints of severe, intermittent abdominal pain of four days' duration. From the history it was learned that he had experienced attacks of abdominal pain during the past two years coming on irregularly at intervals of two to four weeks. These attacks would be present for several hours and then spontaneously leave. He had noted during the

preceding three months that both the frequency and intensity of these attacks had increased. The pain was described as being sharp, cramp-like, located mainly in the umbilical and epigastric regions of the abdomen and would radiate to the back. At times the pain was of such severity that the patient would roll on the floor in agony. Nausea was present and the patient would induce vomiting for relief. He had undergone an appendectomy three years previously. One year following his operation the patient was hospitalized for ten days, the diagnosis of an incomplete mechanical intestinal obstruction being made. A selective dyspepsia to cabbage, fatty and fried foods was present.

On admission the temperature was 99.6° F. rectally, the pulse rate 110, respirations 28 and the blood pressure 124 systolic and 80 diastolic. The essential physical-pathological changes were limited to the abdomen and consisted of moderate distention and tenderness on palpation over the right upper and lower abdominal quadrants. On auscultation, the peristaltic sounds were markedly diminished and metallic tinkles with an occasional rush were heard. Examination of the urine gave negative results, the leukocyte count numbered 9,500 cells per cubic millimeter.

The patient was treated conservatively with Wangensteen suction, parenteral fluids, mineral oil by mouth and repeated tap water enemas. No improvement of the clinical symptoms was observed during the following day and since the

\* From The Department of Surgery, Cook County Hospital, Chicago.

auscultatory findings of the abdomen were indicative of progressive obstruction it was the opinion that a mechanical type of obstruction

pital. Under spinal metycaine anesthesia the abdomen was opened through a right paramedian epigastric incision. The intestinal loops

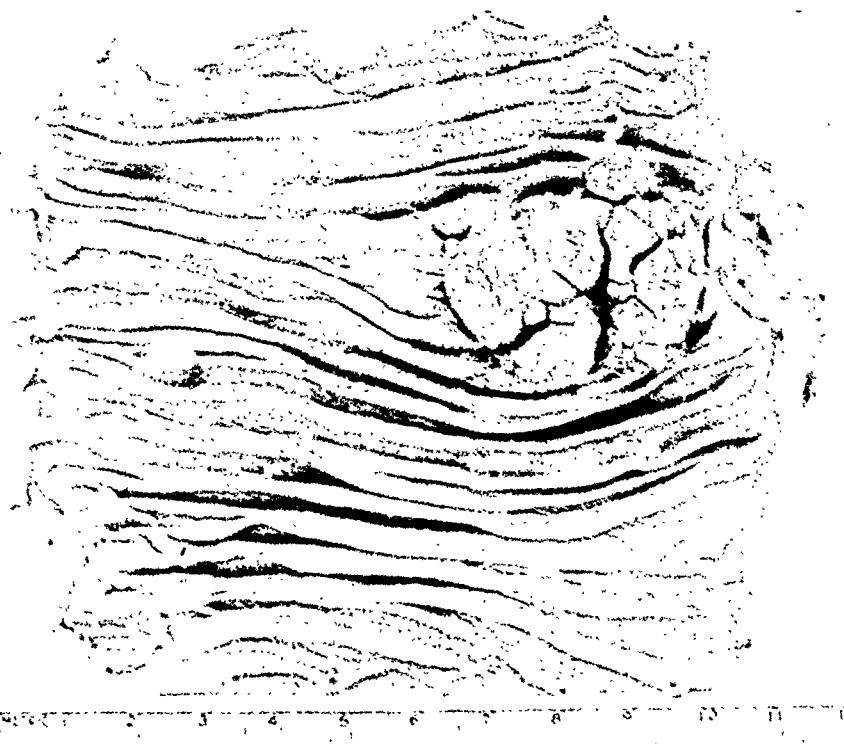


FIG. 1. Photograph of resected portion of jejunum showing a mucus producing adenocarcinoma and adjacent, a jejunal polyp.

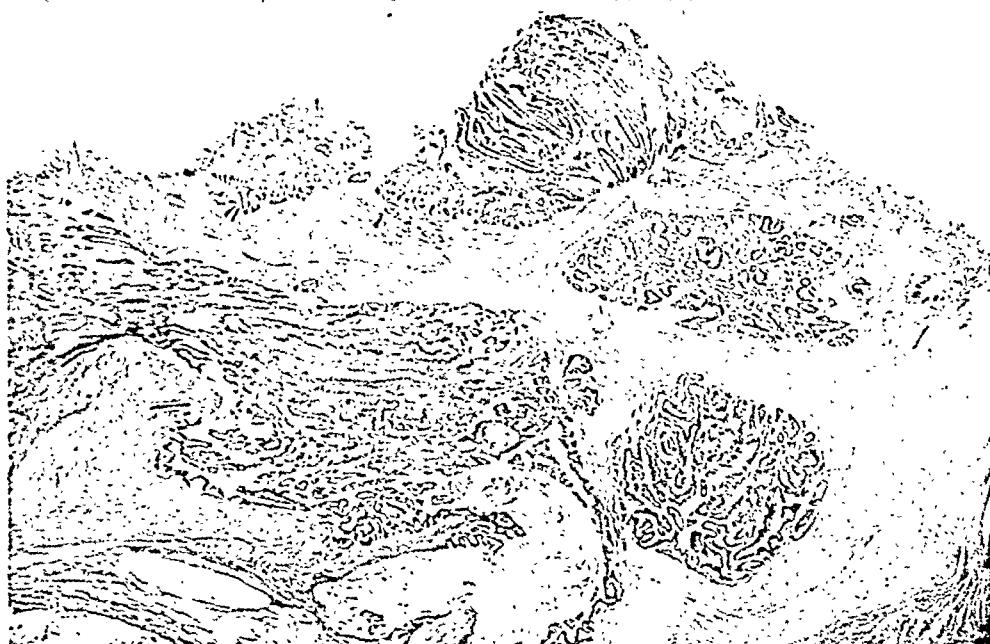


FIG. 2. Low power microphotograph taken from tumor area of the jejunum (hematoxylin-eosin stain  $\times 17.5$ ).

of the small intestine was present and surgical intervention advised.

Operation was performed by one of us (M. E. L.) on the day following admission to the hos-

pit. The upper jejunum were markedly distended; the lower loops collapsed. A considerable amount of serous fluid was present in the peritoneal cavity. Two inches distal to the ligament

of Treitz a jejunojejunal intussusception was present. This was reduced with ease; however, at this site a firm, constricting, infiltrating mass

cosal surface it is deformed by a pedunculated papillary mass measuring  $3.5 \times 3 \times 1.5$  cm. The free surface is cauliflower-like in



FIG. 3. High power microphotograph taken from tumor area showing invasion of the muscularis propria (hematoxylin-eosin stain  $\times 64$ ).

was present. In addition several polypi were palpable. No enlargement of the lymph nodes in the mesentery were palpable, therefore, a wide resection of this area together with its mesentery was performed. The continuity of the intestinal tract was restored by an end-to-end enterico-anastomosis.

The resected specimen was submitted to the Department of Surgical Pathology and was described as follows:

"Grossly, the specimen consists of a segment of the jejunum measuring 9.5 cm. in length and 10.5 cm. in circumference. The serosa is a light purplish gray in color. At a point 1.5 cm. from the mesenteric attachment on its lateral aspect the serosa is wrinkled and puckered and is a darker reddish gray and is adherent to the underlying structures. At this site on its mu-

character, purplish red in color, firm and infiltrates the underlying submucous membrane. On the opposite side of the mass is a pedunculated polypoid structure measuring  $4 \times 3 \times 3$  mm. attached to the mucous membrane by a short broad pedicle  $3 \times 1$  mm. in diameter. The mucosal folds are distinct light purplish gray in color.

"Microscopically, sections taken reveal a mucus producing papillary adenocarcinoma of the jejunum."

The postoperative course was entirely uneventful, multiple blood transfusions, parenteral fluids, intravenous cavitamic acid together with general supportive measures resulted in his being afebrile on the fourth postoperative day. On his fifteenth postoperative day the patient was discharged from the hospital. He has since

remained well and has had no symptoms referable to the gastrointestinal tract. (Figs. 1 to 5.)

of the small intestine from the various clinics. Ewing<sup>1</sup> states that carcinoma of the small bowel forms 3 per cent of all intestinal

FIG. 4.

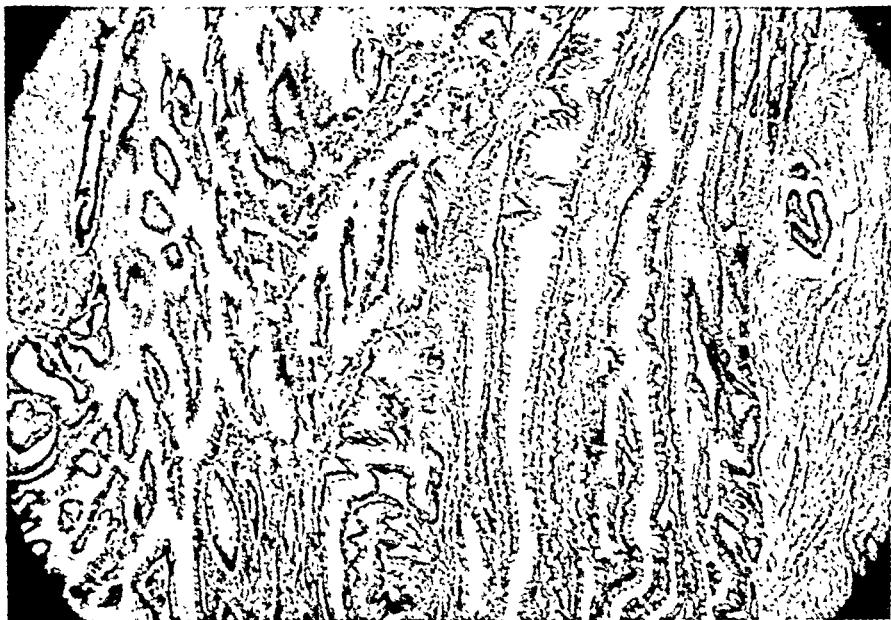


FIG. 5.

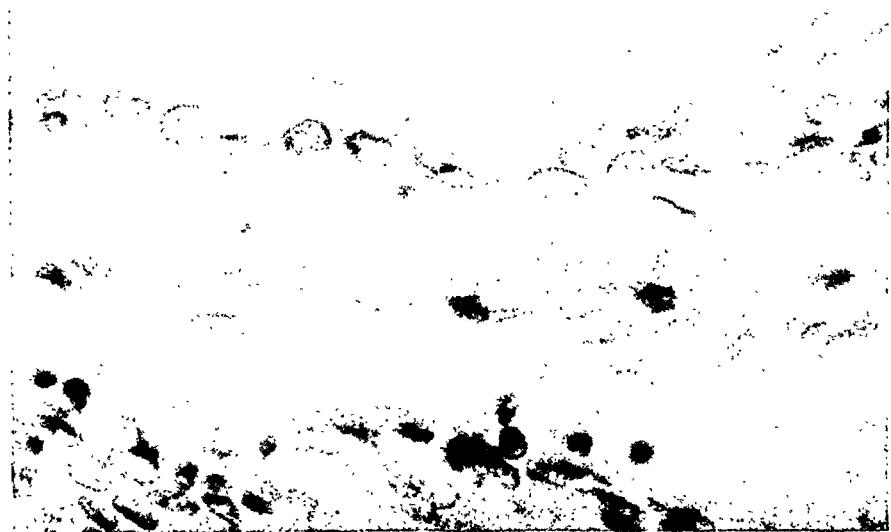


FIG. 4. High power microphotograph taken from tumor area showing mucus producing cells lining the intestinal crypts (hematoxylin-eosin stain  $\times 64$ ).

FIG. 5. High power microphotograph taken from tumor area of the jejunum showing the marked anaplasia with an occasional mitotic figure (hematoxylin-eosin stain  $\times 1280$ ).

#### COMMENTS

From the statistical study given in Table 1 it will be seen that carcinoma of the small bowel is relatively uncommon and occurs with least frequency in the jejunum. Because of this rarity there is some discrepancy in the reported incidence of carcinoma

carcinomas. Mayo and Nattrour<sup>2</sup> in reviewing seventy-six cases of carcinoma of the small intestine observed at the Mayo clinic in the ten years prior to 1936 found that carcinoma of the small bowel comprised 0.62 per cent of all the carcinomas from the cardiac end of the stomach down to and including the rectum and that carcinoma of

the jejunum formed only 0.15 per cent of all the carcinomas of the gastrointestinal tract.

A review of 16,318 consecutive necropsies performed at the Cook County Hospital during the fourteen years from 1929 to 1943 revealed only seven cases of carcinoma of the small intestine. Three were in the duodenum and four in the jejunum.

region chiefly in infancy and once reduced, rarely recurs. Gross causative disease is seldom found.

Many theories have been advanced to explain the cause of primary intussusception, e.g., excessive lymphoid tissue in the terminal ileum (Perrin and Lindsay);<sup>5</sup> mobile cecum (Leriche and Cavaillon);<sup>6</sup> in-

TABLE I  
AUTOPSY STATISTICS

Years	Source	No. of Autopsies	Carcinoma of				
			Small Intestine	Jeju-num	Ileum	Duo-denum	Undeter-mined Site
1870-1893	Vienna General Hospital*	41,838	17	0	10	7	0
1886-1891	Pathologic Institute of Berne*	5,621	9	0	3	6	0
	Zeman*	21,624	9	0	6	3	0
To 1932	Johns Hopkins Hospital <sup>13</sup>	11,500	16	4	3	7	2
1929-1942	Cook County Hospital.....	16,318	7	4	0	3	0
	Total.....	96,901	58	8	22	26	2

\* Cited by Hermann Nothnagel (*Diseases of the Intestines and Peritoneum*, in Nothnagel's Encyclopedia of Practical Medicine, Philadelphia, W. B. Saunders Company, 1904, vol. 8, pp. 402-404).

The relative infrequency of carcinoma of the small intestine has given rise to many theories, among which may be mentioned the embryonic rest theory of Cohnheim. Other authors have attributed the low incidence to the absence of abrupt bends and irritation as is seen in the sigmoid colon and rectum. Carcinoma of the intestinal tract is found at points where there is an abrupt change of the lining epithelium of the canal, e.g., at the junction of the esophagus and the stomach or at the anus and rectum. Rankin and Mayo<sup>3</sup> subscribe to the theory that the fluid nature and the alkaline reaction of the contents of the small intestine may explain the lowered incidence of carcinoma of the small bowel.

In an excellent discussion of intussusception due to intestinal tumors, Fiske<sup>4</sup> distinguishes the primary and the secondary group from its causative factor, or an acute, chronic or recurrent group from its clinical picture. The primary group usually has an acute onset, occurs at the ileocecal

co-ordination of the autonomic system at the ileocecal region where the dual sympathetic and parasympathetic supply of the ileum gives way to the single sympathetic control of the large bowel. (Fraser.)<sup>7</sup>

The secondary group usually has a chronic or recurrent onset, occurs in older children and adults and tends to recur if the causative disturbance is not removed. Intestinal tumors, benign and malignant, intestinal ulcers due to typhoid, dysentery and tuberculosis and Meckel's diverticula are the most common underlying lesions. Benign tumors are more frequently the cause of intussusception than malignant tumors. Rankin and Newell<sup>8</sup> found that intussusception occurred in 17 per cent of a series of thirty-five cases of benign tumors of the small intestine, while in a series of fifty-five cases of carcinoma of the small intestine reported by Rankin and Mayo<sup>3</sup> intussusception was encountered in only two cases (3.6 per cent).

Medinger<sup>9</sup> is of the opinion that malignant tumors of the jejunum and ileum are prone to produce intussusception. This is concurred with by Brown and McHardy,<sup>10</sup> (while Carter,<sup>11</sup> Fiske<sup>4</sup> and Joyce<sup>12</sup> disagree. Raiford,<sup>13</sup> in reporting eighty-eight cases of tumors of the small intestine in a series of 11,500 autopsies and 45,000 surgical specimens found that fifty were benign and thirty-eight malignant. The jejunum was involved in fourteen instances, five cases being malignant the remaining nine benign. In Raiford's series, intussusception occurred in 23 per cent of the cases, the large majority being caused by benign tumors.

In summarizing the clinical symptoms presented in a series of seventy-six cases of carcinoma of the small intestine, Mayo and Nattrour found that in about 80 per cent of their cases a typical clinical history of a lesion of the small intestine was obtainable. Cramps and epigastric discomfort are the most common chief symptoms. Usually there is a history of recurrent short episodes of intestinal obstruction, associated with cramps, nausea and vomiting. These symptoms occur for three or four months and tend to become more frequent and more severe. Gas, rumbling and bloating are common symptoms.

A secondary anemia of the microcytic hypochromic type is generally the case. Plunkett<sup>14</sup> and his co-workers have recently pointed out that the anemia may result from the occult bleeding and the interference with the absorptive function of the small intestine.

While the average age in cases of carcinoma of the jejunum was found by Rankin and Mayo to be 47.5 years, this was later revised by Mayo and Nattrour to 51 years, the youngest patient in their series being thirty-two years of age. In Raiford's series of eighty-eight cases of the small intestine the youngest patient with carcinoma was thirty-three years of age. Joyce reported a case of carcinoma of the jejunum with metastasis in a twenty-five year old Filipino. In the necropsy records of

carcinoma of the jejunum from the Cook County Hospital the average age was 47.5 years; the sexes were equally divided.

#### SUMMARY

A case report of a mucus producing adenocarcinoma of the jejunum with intussusception in a white male, aged twenty-four, is presented.

In a review of 16,318 necropsies performed at the Cook County Hospital four cases of primary carcinoma of the jejunum were found.

From a review of the literature carcinoma of the jejunum is infrequently seen, having an incidence of 0.9 to 0.15 per cent among all the carcinomas of the gastrointestinal tract.

#### REFERENCES

1. EWING, JAMES. *Neoplastic Diseases, A Treatise on Tumors.* 4th ed., p. 727. Philadelphia, 1941. W. B. Saunders Co.
2. MAYO, CHARLES W. and NATTROUR, WALTER S. Carcinoma of the jejunum. *Surg., Gynec. & Obst.*, 65: 303-309, 1937.
3. RANKIN, FRED W. and MAYO, CHARLES, JR. Carcinoma of the small bowel. *Surg., Gynec. & Obst.*, 50: 939-947, 1930.
4. FISKE, FREDERICK A. Intussusception due to intestinal tumors. *Ann. Surg.*, 106: 221, 1937.
5. PERRIN, W. S. and LINDSAY, E. C. Intussusception. A monograph of 400 cases. *Brit. J. Surg.*, 9: 46-71, 1921.
6. LERICHE, R. and CAVAILLON, P. Des conditions anatomiques nécessaires à la production des invaginations iléo-caecales. *Semaine méd.*, 27: 85, 1907.
7. FRASER, J. Involvements of the nervous system in relation to abdominal disease. *Surg., Gynec. & Obst.*, 44: 289, 1927.
8. RANKIN, FRED W. and NEWELL, C. E. Benign tumors of the small intestine. *Surg., Gynec. & Obst.*, 57: 501-507, 1933.
9. MEDINGER, FRED G. *Surg., Gynec. & Obst.*, 69: 299, 1939.
10. BROWN and MCHARDY. Quoted by Medinger. *Surg., Gynec. & Obst.*, 69: 299, 1939.
11. CARTER, R. FRANKLIN. Carcinoma of the jejunum. Report of three cases. *Ann. Surg.*, 102: 1019, 1935.
12. JOYCE, T. M. Tumors of the small intestine. *Ann. Surg.*, 100: 949-959, 1934.
13. RAIFORD, THEODORE S. Tumors of the small intestine. *Arch. Surg.*, 25: 122-177, 1932.
14. PLUNKETT, J. E., FOLEY, M. P. and SNELL, A. M. Primary carcinoma of the jejunum. *Canad. M. A. J.*, 34: 289-293, 1936.

# BILATERAL RENAL LITHIASIS\*

## CASE REPORT

ELMER HESS, M.D.

Diplomate of the American Board of Urology; Chief of Urological Department, St. Vincent's Hospital  
ERIE, PENNSYLVANIA

THE study and treatment of renal lithiasis has advanced more in the past decade than in all of the preceding centuries. The diagnosis and interpretation of pyelograms in stones of the urinary tract has been so perfected that only the rare case will be missed in the course of a complete urological survey. Differential diagnosis between calcified abdominal glands, calcification in intestinal viscera and gallbladder stones may at times be difficult. The reporting of the rare and unusual case keeps our minds alive to these various possibilities when subjective symptoms are vague and urological studies are suggestive. In the non-opaque calculus of the urinary tract, aids such as the wax-tipped catheter and the filling defect in the urogram or the injection of a non-opaque substance that will cling to the stone, usually reveals the true diagnosis. Lateral uograms are necessary where there is a question as to whether or not we are dealing with stones in the kidney or in the gallbladder. Careful study will usually reveal very accurately the correct diagnosis but often the interpretation of uograms may be very misleading and the careful reporting of unusual cases is doubly important in the future reading of similar entities.

The treatment of urolithiasis, while fairly well standardized, calls very often for the best type of individual managerial judgment. What to do, how and when, will often depend upon the judgment and experience of the clinician, aided not only by the interpretation of the anatomical findings but by the sense of values which he may have of the physiological

abilities of the anatomically distorted organs to perform their normal functions.

The following case is reported because there are so many lessons to be learned from it and because a careful study of all of the factors involved in the diagnosis and treatment of this case add much to our knowledge and experience in the future management of certain types of urinary lithiasis. Seldom does a case carry with it so much that may be applied to many cases.

## CASE REPORT

S. M., age forty-four, a white male, was admitted to the Clinic on November 12, 1942; file no. 134404.

The patient had no chief complaint. The history of his present illness showed that several weeks before he was apparently in good health and had applied for life insurance. Upon examination of his urine, an unusually large number of white blood cells and some albumin were found and he was requested to have this checked for some possible urinary tract infection before he was given his insurance. He had no subjective symptoms referable to the urinary tract or to any part of his body. He never had been sick in his life. He had worked as a plumber ever since he was a young man, in all sorts of weather and under all sorts of conditions. He had never had an ache or pain. He was not subject to colds or sore throats. There had been no burning or frequency of urination. He denied all venereal infection. As a result of this insurance examination, he reported to the Clinic for a complete urological survey, principally at the request of his brother-in-law who is a physician.

His past medical history was essentially negative. His physical findings were normal throughout in every particular for a man of his

\* From the Department of Urology, St. Vincent's Hospital, Erie, Pa.

age: Blood pressure 130/80; temperature 98.6°F., pulse 74; respirations 18.

On November 12th, his urine was yellowish

thick tenacious mucopus, making it difficult to wash the bladder sufficiently clear to find the ureters. Both ureters were dilated but appar-



FIG. 1. Plain film showing a right renal staghorn calculus 18 by 10 by 10 cm., a calculus in the left renal pelvis and one in the upper portion of the left ureter.

cloudy; specific gravity 1010; hydrogen ion concentration 7.5; 150 mg. albumin. Microscopically, there were many white blood cells. Blood urea nitrogen was 18.2; blood sugar 94; Wassermann and Kahn tests negative.

The cystoscopic examination showed no obstruction to the scope; there was normal bladder capacity. The bladder was filled with a

ently not inflamed. Catheters were passed to both kidneys and urine dripped from the right but none from the left. The indigo-carmine test was normal from the right kidney, none from the left.

The plain urogram showed a huge staghorn calculus filling the right pelvis and calyces. On the left side, there was a large 25 cm.

calculus opposite the second lumbar body and an oval one opposite the third lumbar. (Fig. 1.)

was seen about the lower calculus. A small amount of dye was seen in the bladder at thirty and sixty minutes. (Fig. 2.)

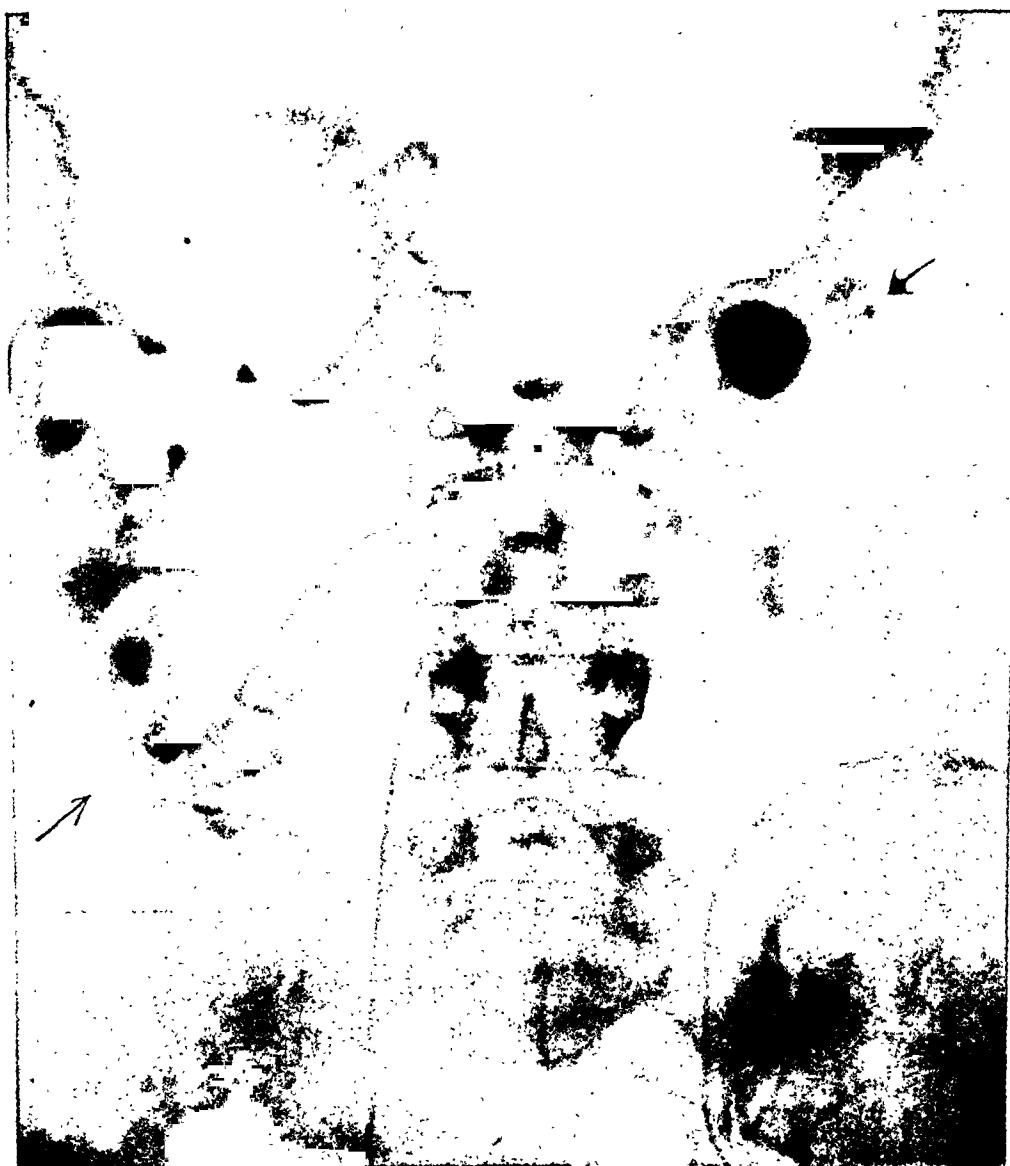


FIG. 2. Thirty minute intravenous pyelogram which shows some secreting renal parenchyma and an intensified shadow of the staghorn calculus on the right side. The arrow points to a single calyx which was functioning in the left kidney, although at operation we had hoped we were dealing with an hydronephrosis on this side. The left kidney was completely destroyed with the exception of the pyramid draining into the single calyx; and life, with a normal blood urea balance, was maintained by the parenchyma that was left on the side of the large staghorn calculus.

A retrograde pyelogram was not attempted because of the obvious damage to both kidneys and following is the report of the intravenous injection.

Ten and thirty minutes after intravenous administration of diodrast, a faint pyelogram was seen about the upper left stone. No dye

No tubercle bacilli were found in the urine. The organism cultured was a hemolytic staphylococcus aureus. Red blood cells 4,600,000; white blood cells 8,600; hemoglobin 94 per cent; polymorphonuclears 72 per cent; s. lymphocytes 21 per cent; monocytes 5 per cent; eosinophiles 2 per cent.

The patient was voiding over a twenty-four hour period approximately the same amount of fluid that he was ingesting. After studying

waiting for that kidney to recover. After the patient had recovered from this procedure, it was hoped that it might then be possible to

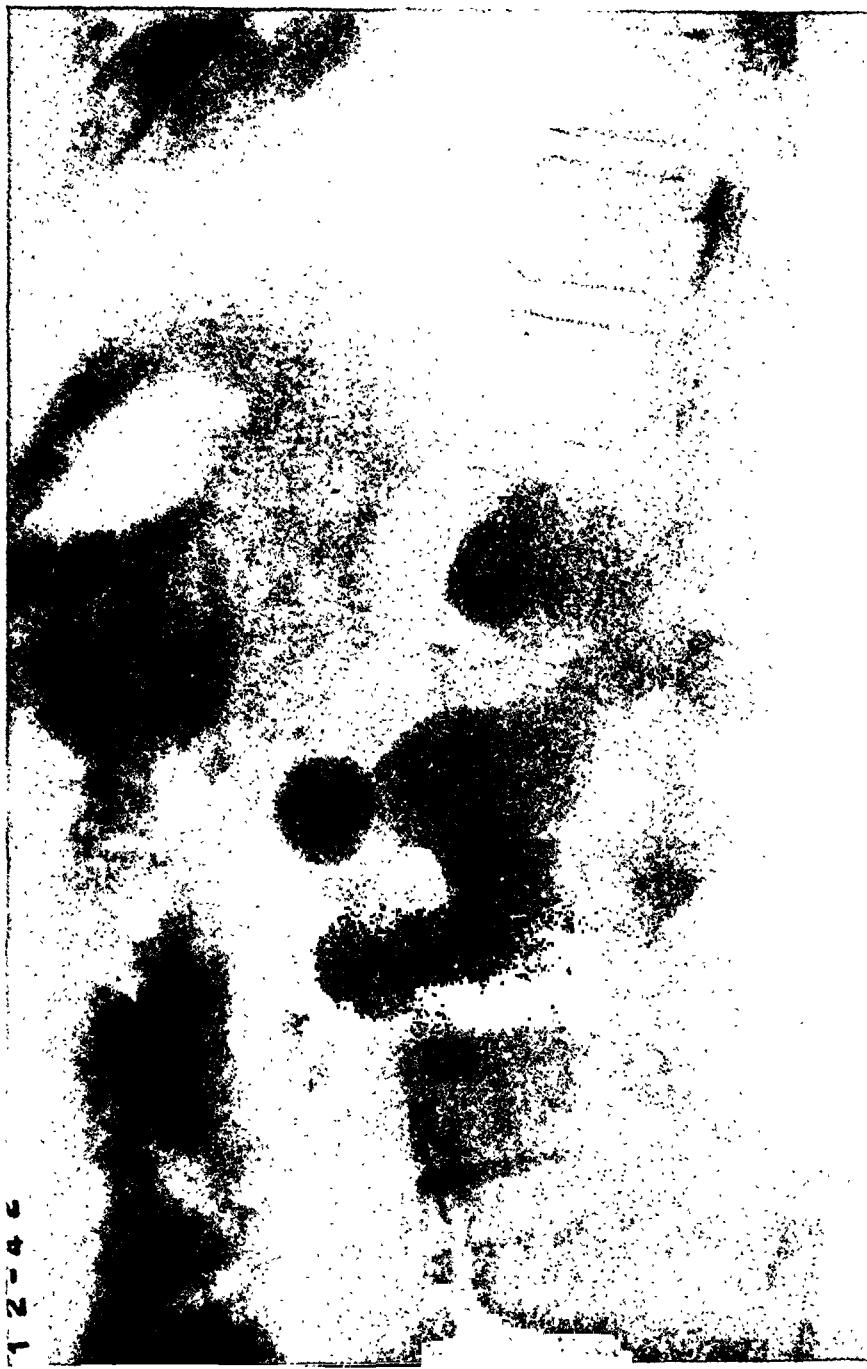


FIG. 3. This is a lateral view of the bilateral renal calculi and shows the excessive size of the calculus in the right kidney, and also shows the single calculus in the left pelvis and the one in the left ureter.

the pyelograms carefully, it was hoped that the stone in the left ureter was blocking a calculous hydronephrosis on the left side. The left kidney was operated upon first. This was done with the thought in mind of doing a nephrostomy on this side, removing the stone in the ureter and the stone in the pelvis and

remove either the large staghorn calculus in the right kidney, or to remove the right kidney completely.

A left nephrectomy was done on November 16, 1942. The incision was made in the skin over the twelfth rib. The rib was removed, transversalis fascia and Gerota's fascia were

opened. A small atrophic kidney bound down with adhesions was found. It was thought best to remove same. The ureter was clamped and ligated and the pedicle was also clamped and ligated. Two cigarette drains were placed in the wound. The muscles were closed in layers with interrupted catgut and the skin was closed with clips.

The left kidney was found to be small, atrophic with a thickened capsule about one-quarter of the normal size, one large stone in the renal pelvis and a large oblong stone in the upper third of the ureter completely blocking same.

A not too unexpected atrophic kidney was found. The patient made an unusually nice recovery from the nephrectomy, which was considered necessary, voided urine normally immediately after the operation and continued to void normally and had no post-operative shock or distress of any kind. He was discharged on November 29th, with a normal temperature of 98.4°F., pulse 80, respirations 20. His wound was completely healed. The urinalysis at this time was: Appearance, yellow cloudy; specific gravity 1007; hydrogen ion concentration 7.5; 75 mg. albumin, very few white blood cells in the urine and many red blood cells.

The patient had no pain on his right side. He was given the choice of having another operation to remove the huge staghorn calculus and to drain the kidney or to let things ride as they were. He elected for the time being to forego any further surgery.

#### Pathological Report: Tissue: Left kidney.

The gross examination showed the specimen to consist of a small atrophic kidney, a thickened capsule, and about 6.5 cm. of ureter. A stone could be palpated in the ureter and also in the pelvis of the kidney. The capsule was stripped with great difficulty and left a surface which was granular and irregular in appearance. On section, very little if any normal appearing kidney tissue was seen. The calices were dilated and filled with straw-colored material. Both the cortical and the medullary regions showed an increased amount of adipose tissue. The pelvis was dilated and contained one stone. This measured 2 by 1.5 by 1.5 cm. The mucosa of the pelvis showed hyperemia and a few small pinpoint areas of hemorrhage. About 2.5 cm. from the junction of the ureter and the kidney, there was another stone present in the ureter which was oblong in shape and

which measured 2 cm. in length and 5 mm. in diameter. Both of these stones were tannish-brown in color. The one in the kidney pelvis was smooth externally, whereas the one in the ureter was irregular and roughened. The ureter was not dilated except at the point where the stone was lodged.

Microscopically a few glomeruli were present. All of these showed thickening of Bowman's capsule and sclerosis of the glomerular tufts. Other hyalinized glomeruli were also seen. The remnants of a few tubules were observed. These did not appear to be of much value from a functional standpoint. Many of them were filled with pink, homogeneous staining material and others showed beginning destruction of their epithelial linings. All of the sections showed a marked amount of hyalinized connective tissue in which lymphocytes were found. All of the blood vessels including both the small ones and the large ones, showed a marked amount of sclerosis.

**Diagnosis:** Chronic pyelonephritis; chronic ureteritis; hydronephrosis; renal and ureteral calculi.

#### COMMENT

This is a very unusual case of bilateral renal lithiasis as the plain film and intravenous pyelograms will show. The staghorn calculus in the right kidney measures 18 by 10 by 10 cm. There is also a large pelvic stone in the left kidney with another one in the upper third of the left ureter. Had we interpreted the intravenous urograms correctly, together with our cystoscopic findings, we might have known that there was an atrophic kidney with one small functioning pyramid. However, we hardly believed that the right kidney, containing the huge staghorn calculus, had enough functioning parenchyma to sustain life and hoped that we were dealing with an hydronephrotic organ on the left side, which could be relieved by removing the stone in the ureter and pelvis, and thought that there might be enough renal parenchyma here to carry the patient while some operative procedure was attempted on the right kidney.

The fact that the patient was symptomless made us believe that the attack on the

left kidney should be done first and when we found the small atrophic kidney upon operation, there was nothing left to do but remove it.

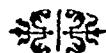
The situation was then carefully explained to the patient and he was told that the right kidney apparently was functioning sufficiently to maintain normal blood urea balance and to sustain life and that surgery might be attempted on the remaining kidney, with the thought in mind that the remaining renal parenchyma would last longer if we were able to remove the large staghorn calculus successfully. All of the dangers of infection and further injury to the small remaining renal parenchyma as a result of infection, et cetera, were carefully explained to him and, of course, the mortality and morbidity possibilities in the event of surgical failure to remove the calculus completely. We believed that the decision for further surgery, after careful explana-

tion, should be left to the patient's discretion.

Nephrectomy, of course, would have been indicated on the right side if the patient had possessed a nearly normal left organ.

It is interesting to note that the blood pressure in this particular case is perfectly normal. The patient is still alive and comfortable six months after the left nephrectomy from which he recovered very promptly and with an uneventful convalescence. He is working as a plumber every day and is apparently in good health and free from symptoms.

This is the largest staghorn calculus I have ever seen and the case is particularly interesting because of the fact that the renal parenchyma on this side has sustained life for a long period of time and is still capable of maintaining normal blood chemistry balances.



# ACUTE HEMORRHAGIC PANCREATITIS\*

## A NEW ETIOLOGICAL CONCEPT AND CASE REPORT

NATHAN N. BRODIE, M.D. AND

Assistant Attending Surgeon, Kings County Hospital

BERNARD J. FICARRA, M.D.

Resident Surgeon, Kings County Hospital

BROOKLYN, NEW YORK

**T**HREE is one disease in surgery which is an unsolved problem from many aspects. The mortality is high, the pathology not entirely understood, the diagnosis infrequently made, and the etiology remains within the realm of speculation.

The factors producing acute hemorrhagic pancreatitis as well as its exact cause are unknown. The classical concepts of the pathogenesis of this disease were promulgated by Wangensteen in 1931, and by Dragstedt in 1934. The latter concluded that 60 per cent could be explained on the old common channel theory, 10 per cent of these being caused by stone in the ampulla and the remainder by spasm or edema of Oddi's sphincter as reported by Archibald.

In general, McWhorter's classification on an etiological basis is as useful as any other system. Accordingly there are three major origins of this disease: (1) Infectious origin; (2) non-infectious origin, and (3) combinations of two or more factors. The infectious group includes all avenues of bacterial invasion. The non-infectious heading is subdivided into the mechanical or obstructive causes, chemical factors due to bile, the degenerative changes and traumatic pancreatitis.

Another contribution to the etiology of this disease was made by Binet (1929) when he reported his experimental work. He postulated the humoral syndrome of hemorrhagic pancreatitis. Other men as Weiner (1939) advanced the belief that alcohol in some way was related to the causation of this disease.

Within the past decade, experimental evidence has been published by European investigators and authors which lends

credence to another etiological factor, namely, anaphylaxis. Smull has termed this, pancreallergy. Predisposing causes to this state of allergy has been attributed to trauma, alcohol, adiposity, arteriosclerosis, gastrointestinal disturbances, especially gastroduodenitis, chronic cholecystitis, and cholelithiasis. In most instances these states, with the exception of biliary tract disease, are considered secondary contributing causes. Those with inborn allergic sensitiveness of the pancreas or sphincter of Oddi may develop repeated attacks of pancreallergy without a predisposing factor present. In the majority of cases chronic cholecystitis and cholelithiasis with or without the associated chronic pancreatitis and the usual presence of micro-organisms are the most potent agents sensitizing the sphincter of Oddi.

In substantiating the allergic basis for pancreatitis, some authors have postulated anaphylactic shock as the cause for the disease. It is described as an anaphylactic shock of the neurovegetative system. This shock has been produced experimentally by foreign proteins or by substances which are toxic for the tissues. The French experimenters, Couvelaire and Bargeton, attempted to investigate the provocation of pancreatitis in 1933.

Experiments were carried out on six dogs. All were operated upon during the process of digestion. Gentle handling eliminated the traumatic factor. Horse serum was used as an anaphylactic substance. When sacrificed the pancreas showed slight hemorrhagic suffusions and hemorrhagic edematous congestion. The involvement of the pancreas was secondary. All the

\* From the Surgical Service of Dr. Benjamin M. Cissel, Kings County Hospital, Brooklyn, New York.

viseera showed multiple hemorrhages. The second animal was sensitized by an intravenous injection of 20 cc. of horse serum. After twenty-three days a laparotomy under local anesthesia was performed. Four cc. of horse serum was injected into the pancreaticoduodenal vein and 0.5 cc. directly into the glandular tissue; later the vein was ligated. Signs of generalized shock were almost completely absent. A diffuse localized persistent pancreatic edema appeared immediately. Twenty-four hours later the dog was in good condition. It was sacrificed. The autopsy revealed some serosanguineous fluid in the peritoneal cavity with many white spots of fat necrosis on the omentum. The pancreas was edematous and contained scattered multiple hemorrhages of irregular distribution. The third and fourth animals presented a similar picture following identical treatment. The fifth and sixth dogs were controls in the experiment. From these experiments the authors drew the conclusion that edematous and hemorrhagic pancreatic lesions can be produced experimentally on the basis of local anaphylaxis.

An Italian investigator, Bezza, investigated this problem in 1938. He was able to produce in dogs, with almost absolute constancy, the pathological picture of acute pancreatitis. Both macroscopic and histological pathological evidence was offered. In one hour he could produce by Arthus phenomenon an acute diffuse pancreatic edema. Later at variable hours hemorrhage would appear, as well as steatonecrosis without an inflammatory reaction.

Dr. Bezza experimented with sixteen dogs each of which received 8 cc. of normal horse serum subcutaneously for five consecutive days. In thirty-five to forty days the dogs would be sensitized as proved by means of the Ascoli precipitation test. Then by means of laparotomy, according to Brocq's technic, 5 cc. of normal horse serum was injected into the duct of Wirsung. Half of sixteen dogs

were injected during the process of digestion; the others were injected while fasting. The dogs were sacrificed at different intervals of time. By this procedure of sensitivity, he produced a pathological picture in dogs which was pathologically similar to acute hemorrhagic pancreatitis of human beings.

At Kings County we have encountered a case of pancreatitis which we believe has some association with anaphylaxis. As previously mentioned the sensitizing factors are frequently chronic cholecystitis with cholelithiasis. The precipitating cause was sodium morrhuate employed in the treatment of varicose veins.

Allergic reactions following the injection of sodium morrhuate are not unknown. The mechanism in the production of allergy with this drug is not fully understood. Rosenzweig studied this problem. After studying a large series of cases, in which sodium morrhuate was used, he found very few reactions (about 12 per cent) with the first injection of the antigenic substance; the majority or 87 per cent of reactions take place during the course of treatment. Some reactions can occur as late as the twenty-third injection. Authorities are not uniform as to the cause of allergy with sclerosing solutions of sodium morrhuate. Some (Rosenzweig et al.) believe that it may be due to a protein fraction in the sclerosing substance. Other (Zimmerman and DeTakats) maintain that the allergic-like responses may be due to saponified fatty-acids themselves or to an admixture with liver proteins, or to hemolysis caused by the solution and resulting in the liberation of a protein substance.

Whatever the mechanism may be in the production of allergic manifestations with sodium morrhuate, is not pertinent here. We believe that the case presented may be demonstrable of pancreallergy, due to this drug. In this instance the diagnosis of acute hemorrhagic pancreatitis was established and confirmed by operative examination. The conclusive operative findings

were as follows: An abundant blood stained abdominal fluid was present. (Culture of this fluid demonstrated non-hemolytic streptococci and staphylococci.) The omentum, mesentery, and serosal surface of the visible abdominal organs contained innumerable small whitish yellow plaques indicating true fat necrosis. The pancreas was dark red in color and markedly enlarged. The gallbladder was distended and contained numerous multifaceted calculi.

#### CASE REPORT

The patient was a forty-eight year old housewife who entered Kings County hospital on November 11, 1942, with a chief complaint of generalized abdominal pain. The pain began four days before admission at which time it was sudden in onset, diffusely distributed over the abdomen, radiating to the right flank and down both legs. Later it radiated to the left shoulder and interscapular area. The initial onset of pain followed by eight to twelve hours a weekly injection for varicose veins at another hospital. The patient vomited at the onset of the pain. Vomiting was always preceded by nausea. As the pain increased in severity, the patient's abdomen became distended. She was admitted finally to Kings County hospital. At the time of admission, the fourth day of her illness, she had not had a bowel movement in forty-eight hours. The only nourishment in three days was a little tea and ginger ale.

For three weeks prior to her hospitalization, the patient received weekly injections of 1½ to 2 cc. of sodium morrhuate for bilateral varicose veins. Four months before she had an attack similar to this present illness, not known whether preceded by any injection therapy. However, this former illness was transitory, lasting three days and much milder in intensity. Ten years ago she was told that she had kidney trouble. There was no history of accidental injuries or operations.

Physical examination on admission revealed a well developed, well nourished, white, obese female, forty-eight years of age in acute distress and shock. Blood pressure was 90/60, pulse 120, fair quality and tension, temperature 102.2°F., respirations were 38, rapid and shallow; slight dyspnea was noted. Examination of the head and neck revealed nothing unusual. Heart

sounds were distant with a questionable mitral systolic murmur. Respirations were rapid and shallow. There was no alteration of percussion sounds but bilateral basal moist râles posteriorly were heard. The abdomen was distended, tender throughout with a point of maximum tenderness in right upper quadrant but not tympanitic. There was moderate tenderness in the right costovertebral area and peristalsis was audible. The only significant finding in the rectum was a soft bulging mass of the right rectal wall. The extremities showed marked bilateral varicose veins; some were indurated.

Laboratory data on admission to the medical service were as follows: White blood cells 12,800 with 80 per cent polymorphonuclears; red blood cells 3,810,000; hemoglobin 65 per cent; urinalysis revealed positive albumin. Impression: Perforated acute gallbladder or peptic ulcer.

Three hours after admission the patient was transferred to the surgical service and again examined and found to have a diffusely rigid abdomen, most marked in the upper half of the abdomen. Marked tenderness was elicited in the right upper quadrant and to the right of the umbilicus. A mass was felt in the right upper quadrant. The mass moved easily with respiration. There was no obliteration of liver dullness. The palpable mass was believed to be gallbladder.

Following the intravenous administration of fluid and plasma it was decided to perform a laparotomy (seven hours after admission). At this time the pulse was 90 and the blood pressure 115/78.

The patient was operated upon and expired during the operative procedure as the fascia was being closed. The procedure was an exploration of the abdominal viscera, followed by cholecystostomy. The patient was under ether for fifty-four minutes at the time of death. Sulfathiazole was placed into the peritoneal cavity. Drains were inserted to the body of the pancreas and under the gallbladder.

The peritoneal cavity contained 1,500 cc. of hemorrhagic fluid. The greater omentum, mesentery, and serosal surface of the visible abdominal organs were studded with numerous areas of necrosis. The pancreas was slightly enlarged, soft in consistency, hemorrhagic in appearance, reddish brown in color. The gallbladder was distended and contained numerous multifaceted calculi.

**Operative Diagnosis:** (1) Acute hemorrhagic pancreatitis; (2) subacute cholecystitis with cholelithiasis.

#### CONCLUSION

It is not proved beyond all doubt that a direct causal relationship exists between the disease entity found at operation and the injection received by this patient. Nevertheless, in view of the experimental evidence found in the literature, this anaphylactic etiological concept should not be entirely disregarded. A thought is advanced, therefore, that in the pathogenesis of acute pancreatitis one ought to consider in association with other causes, the theory of anaphylaxis. With the postulation of this theory, it is hoped that other clinicians and experimenters will substantiate this contention with additional evidence.

#### REFERENCES

1. ALLENDE, JUAN M. Acute pancreatitis and its treatment. *Prensa méd. Argentina*, 29: 982, 1942.
2. BEZZA, PETER. Acute pancreatitis produced experimentally by allergic phenomenon. *Italian Arch. Surg.*, pp. 545-571, 1938.
3. BINET.<sup>6</sup>
4. BROcq, PAUL. Some new ideas on hemorrhagic pancreatitis. *J. Surg.*, (Paris), 25: 7, 1925.
5. BROcq, PAUL. Pancreatitis Produced Surgically. Paris, 1926. Masson & Co.

6. BROcq, BINET, and UNGAR. Humoral syndrome of hemorrhagic pancreatitis. *Presse méd.*, 37: 848, 1929.
7. CHRISTMANN, FRED. Action of quinine in the experimental production of pancreatitis. *Bol. y trab. de la Soc. de cir. de Buenos Aires*, 14: 32, 1930.
8. COUVELAIRE, R. and BARGETON, D. Some experimental results concerning the genesis of acute edema and pancreatic hemorrhages; anaphylactic pancreatitis. *Compt. rend. Soc. de biol.*, 113: 1435, 1933.
9. DELATOUR, H. B. Traumatic pancreatitis. *Ann. Surg.*, 74: 435, 1921.
10. DRAGSTEDT, L., HAYMOND, H. and ELLIS, J. Pathogenesis of acute pancreatitis. *Arch. Surg.*, 28: 232-291, 1934.
11. FALLIS, L. and PLAIN, G. Acute pancreatitis. *Surgery*, 5: 358-373, 1939.
12. FERRANDEZ-SEANTE, V. and BROGGI-VALLÉS, M. Modern conceptions concerning acute pancreatitis. *Ann. Surg.*, 74: 435, 1921.
13. LEWISON, E. F. Acute pancreatitis: an etiologic review. *Arch. Surg.*, 41: 1008, 1940.
14. WEINER, H. A. and TENNANT, R. A statistical study of acute hemorrhagic pancreatitis. *Am. J. Med. Sc.*, 196: 167, 1938.
15. McWHORTER. Quoted by Lewison.
16. ROSENWEIG, S., ASCHER, M. S. and ZLOTKIN, L. Varicose veins, allergic reactions in injection treatment. *J. Michigan M. Soc.*, 40: 800-806, 1941.
17. SMULL, JOSEPH S. Diseases of digestive system and food allergy.
18. WANGENSTEEN, O. H., LEVEN, N. and MANSON, M. H. Acute pancreatitis. An experimental and clinical study with special reference to the significance of the biliary tract factor. *Arch. Surg.*, 23: 47-73, 1931.
19. ZIMMERMANN and DETAKATS. Allergic like reactions from sodium morrhuate in obliteration of varicose veins. *J. A. M. A.*, 102: 1216-1217, 1934.



# POLYPOSIS OF THE GALLBLADDER\*

## REPORT OF A CASE DIAGNOSED PREOPERATIVELY BY ROENTGENOLOGIC EXAMINATION

J. GREGORY GREGO, M.D.

AND

HENRY N. HARKINS, M.D.

Assistant Resident in Surgery, Henry Ford Hospital

Diplomate of the American Board of Surgery

DETROIT, MICHIGAN

**T**HIS case of polyposis of the gallbladder is reported for three reasons:

(1) Rarity, as shown by a paucity of reports or descriptions in the literature, (2) prophylactic importance, because of a possible predisposition of the polypoid growths to carcinoma, and (3) interest, because of the preoperative roentgen diagnosis and to stimulate further such diagnosis in these cases.

### CASE REPORT

N. W., female, age fifty-two, was admitted to the Henry Ford Hospital on February 24, 1942, complaining of bleeding from the rectum, weight loss, and abdominal distress centered in the epigastric region and left lower quadrant. Bleeding from the rectum had become increasingly frequent during the past two months, with a loss in weight of ten pounds over the same period. This loss of weight was proportionately sizable as the original weight was 104 pounds. The epigastric distress had been intermittent for three months and was associated with nausea and vomiting only in the last few days. Pain in the left lower quadrant was definitely relieved by defecation.

Physical examination was essentially negative. Proctoscopic examination revealed multiple small polypoid growths in the rectal canal about and above the first rectal valve. Surgical consultation concerning the epigastric pain suggested cholecystitis, with no evidence of masses. Surgical removal of the rectal polyps revealed them to be benign. Pelvic examination demonstrated only senile mucosal changes, with senile atrophy of the uterus and adnexae.

Among the diagnostic procedures the blood count showed only slight anemia with the hemoglobin 12.5 Gm., red blood cells 4.32 million, white blood cells 4,750, and a normal differential count. Blood cephalin cholesterol was

3 plus, and fasting blood sugar 80 mg. Urinalysis showed a few leucocytes and 2 plus epithelial cells, specific gravity 1.010, and albumin and sugar negative. Examination of the stool some time after removal of the polyps in the rectum revealed no blood, no mucus, one plus bile, and was otherwise negative as was the culture. Fractional gastric analysis showed 4 plus mucus, and was negative in other respects. Transduodenal biliary drainage revealed absence of "B" bile. Gastrointestinal roentgen examination demonstrated normal serial films of the stomach. No organic defects were observed on barium studies of the colon. Cholecystograms (Fig. 1) taken February 28, 1942, showed "the gallbladder shadow well visualized in the 12 and 16 hour examination. There are a number of small negative shadows of sharp outline. These are somewhat different than the usual negative shadows due to gallstones, rather we believe that the possibility of polypi of the gallbladder will have to be considered."\*

The patient was discharged at this time for follow-up treatment in the out-patient clinic mainly for psychologic reassurance because of her intense fear of "cancer growth," and to attempt to re-establish her weight. She was readmitted into the hospital on April 30, 1942, for cholecystectomy. Blood examinations at this time showed only slight increase in red blood cells to 4.59 million, hemoglobin 12.5, white blood cells 4,850. Serial bromsulfalein examinations were normal. Blood cephalin cholesterol was 4 plus. Preoperative preparation included a high protein, high carbohydrate diet.

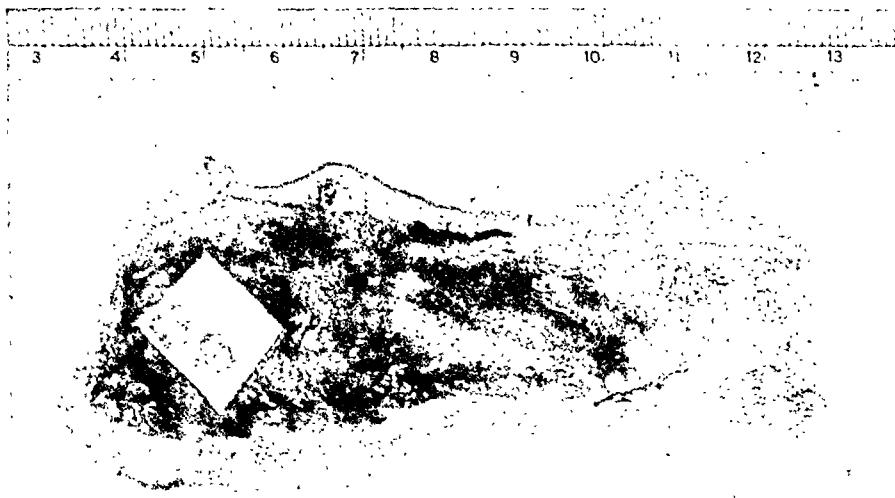
Operation was performed in May 2, 1942, by one of us (H. N. H.) using ethylene-ether anesthesia. The abdomen was opened by transverse incision through the right rectus muscle and sheath about 3 cm. above the umbilicus. Abdominal exploration of the genitalia, stom-

\* Quoted from x-ray diagnosis by Dr. Howard P. Doub, Chief Roentgenologist, Henry Ford Hospital.

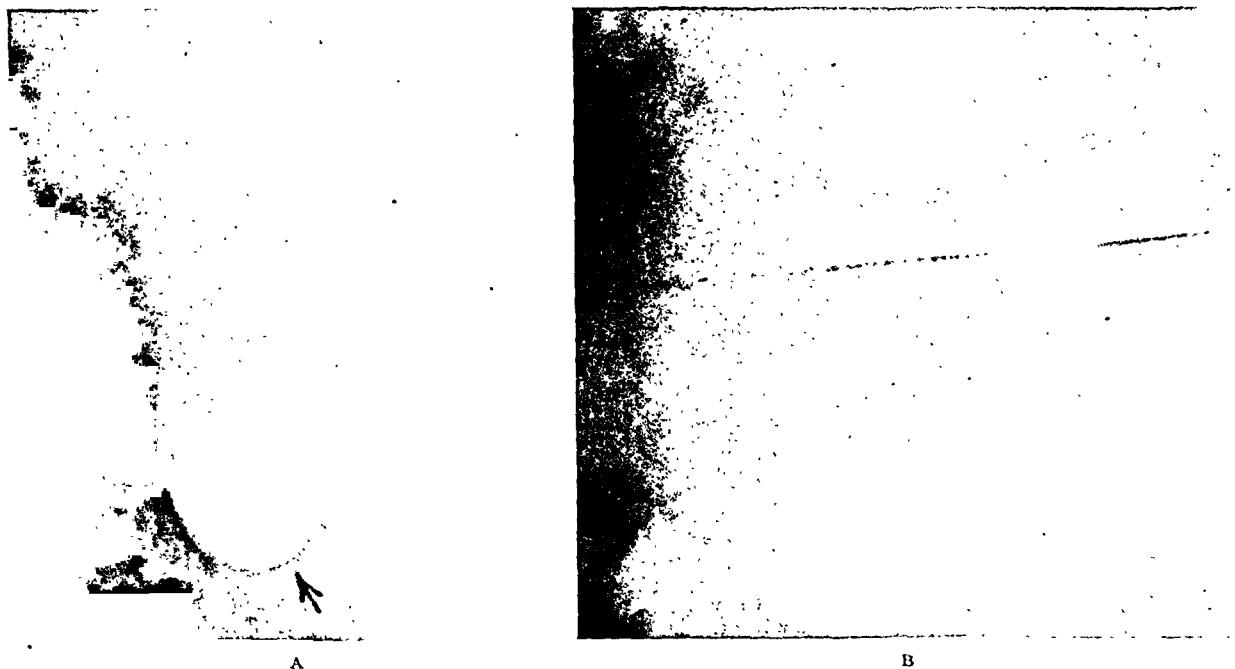
\* From the Division of General Surgery, Henry Ford Hospital, Detroit.

ach, duodenum, pancreas, intestines, common duct, and liver revealed no abnormality. The gallbladder was small and although the walls

were definitely pedunculated. No stones were present and otherwise the gallbladder did not appear diseased as seen in Figure 2. The abdo-



**FIG. 1.** Photograph of opened specimen showing two polyps of the gallbladder. The fundus is to the left, the cystic duct end to the right. The polyps are outlined against a background of paper and the dim outline around the polyps is caused by water on the paper. The very thin pedicles are clearly shown. It is difficult to recognize in this photograph the four flat papillomas which are also present.



**FIG. 2.** Two views of the gallbladder region after dye administration showing roentgenologic outline of polyps of the gallbladder.

were thin no masses could be palpated in it. It was removed from the duct upward with separate ligation of the duct and the artery supplemented by transfixion of the duct. The gallbladder when opened was found to contain clear, yellow-brown bile and about a half dozen small polyps of the fundus region; two of which

were thin no masses could be palpated in it. It was removed from the duct upward with separate ligation of the duct and the artery supplemented by transfixion of the duct. The gallbladder when opened was found to contain clear, yellow-brown bile and about a half dozen small polyps of the fundus region; two of which

men was closed in layers with interrupted sutures of silk throughout. A cigarette drain was brought out through a stab incision 2 cm. above the main wound.

The specimen consisted of an opened gallbladder measuring 7 by 3 cm. The serosa was smooth, the wall was not thickened, and the

mucosa was yellowish-green and smooth. There are three, 2 mm. masses connected to the mucosa with slender stalks measuring 0.5 cm. in length. These polypoid masses were the same color as the mucosa. Microscopically, there was infiltration of round cells in the wall of the gallbladder. The mucosa also contained a similar round cell infiltration and had hypertrophied at one point with the production of a polypoid adenomatous growth. This appeared benign in character. Impression: Polyposis of the gallbladder.

The postoperative course was uneventful. Treatment included large amounts of glucose and cavitamic acid. No complications developed, except for slight anemia. The drain was removed in four days, and the usual slight serous drainage persisted for three days from the drain wound. The patient was discharged twelve days after operation and was followed in the out-patient clinic for three visits, the last being one month postoperatively at which time she had no complaints.

#### COMMENT

Kirklin (1931) reported that in theseventeen-year period preceding 1931, at the Mayo Clinic papillomas were found in 8.5 per cent of more than 17,000 gallbladders surgically removed. He reported that the polypoid masses are small, seldom larger than 1 cm. in diameter, and may be single or multiple. When multiple there are usually not more than two or three and they tend to occur more often in gallbladders which are otherwise normal or present only faint microscopic signs of disease, but they may occur also in association with chronic catarrhal cholecystitis and with cholelithiasis, especially with a single stone. In only one instance was carcinoma noted among the 1,400 cases of gallbladder papilloma seen at the Mayo Clinic. This applies, however, only to the time of operation and does not mean that some others of these might not have become malignant later. Kirklin reported four cases at that time with roentgenologic diagnosis of papilloma confirmed at operation. In a later report (1933) he stated that he had made such a diagnosis in fifty-one cases. Operation was performed in

fifteen cases and in fourteen cases the diagnosis was confirmed, while in the last instance only small cholesterin stones were found.

In 1931, Heske reported a case diagnosed roentgenologically while Moore (1935) reported two cases in which the diagnosis could have been made, but was not done until after operation when the films were reviewed. In another of Moore's cases of adenoma, such a diagnosis was made before operation. Phillips (1933) reviewed the group of 500 gallbladders surgically removed at the Mayo Clinic between 1923 and 1929 which proved to contain one papilloma or more. They occurred especially in females, during the fourth and fifth decades of life, and in early disease of the gallbladder. Concerning malignancy, Phillips states: "Malignancy was seen in only one of my group of 500 papillomatous gallbladders, and even in that instance, not etiologically associated with papilloma. It would not appear that malignancy would occur any more frequently in papillomas than in adjoining villi, since papillomas are only hyperplastic villi laden with cholesterol."

#### SUMMARY AND CONCLUSIONS

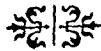
A case is reported of polyposis of the gallbladder in a fifty-two year old woman diagnosed preoperatively by roentgen examination. A study of the literature reveals that papillomas of the gallbladder may occur in about 8 per cent of surgically removed specimens. The condition is especially apt to occur in females and during the fourth and fifth decades. Papillomas of the gallbladder are associated with early disease of the gallbladder, they occur in the fundus and may give rise to symptoms of cholecytic disease.

The possibility that papillomas of the gallbladder may be a source of carcinoma is to be considered but is as yet unproved. The realization that these lesions can be diagnosed roentgenologically is of great value in preventing this latter complication. Observations of a series of papillomas

diagnosed roentgenologically and followed in selected instances over a period of time presents the only sure means of deciding whether these lesions do lead to carcinoma.

## REFERENCES

1. KIRKLIN, B. R. Cholecystographic diagnosis of papillomas of the gall-bladder. *Am. J. Roentgenol. & Rad. Therapy*, 25: 46-50, 1931.
2. KIRKLIN, B. R. Cholecystographic diagnosis of neoplasm of the gall-bladder. *Am. J. Roentgenol. & Rad. Therapy*, 29: 8-16, 1933.
3. HEFKE, H. W. Die Diagnose von Papillomen der Gallenblase mittels Cholezystographie. *Röntgenpraxis*, 3: 871-873, 1931.
4. MOORE, C. Cholecystographic diagnosis of papillomas and tumors of the gallbladder. *Am. J. Roentgenol. & Rad. Therapy*, 33: 630-635, 1935.
5. PHILLIPS, J. R. Papilloma of the gallbladder. *Am. J. Surg.*, 21: 38-42, 1933.



TWO-THIRDS of all human cases of actinomycosis occur in the neck and face. There is increasing evidence that the ray fungus gains entrance through a wound of the buccal mucosa, particularly after tooth extraction.

# ABDOMINAL PREGNANCY

## CASE REPORT

SAMUEL A. DIBBINS, M.D.\*

Surgeon on Staffs of Lowell General and St. Joseph's Hospitals  
LOWELL, MASSACHUSETTS

**A**BDOMINAL pregnancy, while not uncommon, is regarded as one of the rarer complications of pregnancy. A large number of cases have been reported and much interesting literature has been published on this subject. Each case of abdominal pregnancy has been considered unusual enough to justify reporting from its individual standpoint.

I am submitting the following case as being of special interest, first because the patient had been operated upon a year previously for an extra-uterine pregnancy, and second because following her discharge from the hospital at this time she was readmitted a month later for removal of the placenta.

The interesting feature in these cases is, of course, what is going to happen to the placenta: (1) it is usually absorbed; (2) it may undergo necrosis and subsequent infection and form an intra-abdominal abscess which may later necessitate drainage; (3) the mass may become calcified as in any other foreign body in the abdomen and wall off. The first condition is the most likely to happen. There is a report of a case in the *American Journal of Surgery* for December, 1931, in which the placenta was left in and the abdomen was opened a year and a half later, at which time there was no sign of any placenta and no membranes could be found.

In the case herewith reported the fetus was a lithopedion, apparently full term; the thighs and legs were almost stony hard, as were the upper extremities. There did not seem to be any chin and this is in keeping with the findings of other men, about 30 or 40 per cent of fetuses in abdominal

pregnancy presenting the appearance of monstrosities. The fetus in this case weighed 9 pounds, 4 ounces.

## CASE REPORT

I. W., a white female, age twenty-three years, was admitted to the Lowell General Hospital on December 6, 1941. The patient had had an extra-uterine pregnancy one year ago for which she was operated upon and at which time a suspension of the uterus was done. She had had a previous appendectomy many years ago.

Upon her return from the hospital following the operation for this extra-uterine pregnancy, she continued to have abdominal pain of a crampy nature and this became so severe that she was hospitalized twice during the month of March for a few days each time, and she claimed that she did not get relief from the pain. Up until March her periods had been regular. Her periods stopped in March and she did not menstruate again.

She was seen for the first time in June and a vaginal examination at that time showed an enlarged uterus, which seemed in keeping with a three months' pregnancy. She still complained of generalized abdominal discomfort but I saw her several times during the summer and she had some discomfort but was up and about, leading a normal life except for the more than usual amount of abdominal pain.

I examined her in October and noted that the position of the uterus was transverse and rather high. The fetal heart was good, blood pressure and urine within normal limits. I saw her at times during October and November and her abdominal pain was so acute that she required codeine and sal codeia for its relief. I saw her the last time prior to her hospitalization about the 19th of October. At that time the fetus was still lying transversely and the fetal heart was good. Blood pressure and urine still normal.

\* Dr. Dibbins is now a Major in the Medical Corps of the United States Army.

She was not seen again until the day of admission to the hospital when her family called and said she had not had a bowel movement for the past five days, even with the use of various cathartics. She was seen at her home and was obviously having severe abdominal discomfort. She was at term. The fetal heart could not be heard at this time and the patient stated she had not felt any movement for five or six days. The fetus was still lying transversely and high. Blood pressure was good; the heart action was a little rapid, pulse of 112, but otherwise negative.

On admission to the hospital an x-ray was taken, showing a full term fetus, transverse position; the fetus was very high in the abdomen with the head lying on the left, breech on the right. It was recommended that she have a cesarean section for the removal of a high transverse fetus, the family being notified that it was believed the fetus was dead and that this was the only proper method of delivery in this case.

I had a premonition that this was going to be a difficult operation and had a blood donor in readiness and soon after the anesthesia was started we began the use of saline intravenously, and while operating shifted over to blood and gave the patient a transfusion.

The abdomen was opened in the midline from the symphysis to the umbilicus, cutting out the old scar of the operation for extrauterine pregnancy. The peritoneal cavity was opened with difficulty. Considerable adhesions were encountered and once inside the peritoneal cavity what seemed to be an enlarged uterus, extending up about three to four inches above the umbilicus, presented itself. This was not the usual clear cut appearance of a uterus but all sorts of adhesions and scar tissue presented themselves. At the fundus there was a bluish area about two inches in length with soft tissue pouting through. I still was not thinking in terms of abdominal pregnancy and thought this was a rupture of the uterus, possibly with a pouting through of the placenta and a scarring over, and anticipated that behind this mass probably would be the fetus.

This area was incised and a finger inserted into what seemed like placental tissue, rather spongy, and bleeding rather easily, but no fetus. I kept going back to the fundus of the uterus and feeling this indurated mass of

tissue, which seemed to separate up into the upper abdomen and while doing this evidently ruptured into the amniotic sac for immediately there was a spill of meconium. The hand was thrust in further and the fetus found. The fetus was removed with great difficulty; it proved to be a lithopedion, apparently full term; the thighs and legs almost stony hard, as were the upper extremities, and there did not seem to be any chin. Evidently on rupturing the membranes a vein was either ruptured in the membrane itself or in pulling the baby out of the abdomen the placenta was separated from its underlying tissue, and profuse bleeding ensued, just as if one had turned on a faucet.

Fortunately, the patient was being given blood transfusion but she was losing blood much more rapidly than she was getting it. I tried to pack off the area with large sponges and towels where I thought the blood was coming from, but the bleeding did not seem to stop. Finally, I pressed on the aorta itself and continued to pack, and after four or five minutes the bleeding was stopped. The cord was cut close to the placenta and it was believed that there was nothing else to do but leave the placenta *in situ*. As far as could be determined, the placenta was attached to the top of the uterus at the fundus, to the greater omentum, and possibly to the greater curvature of the stomach. I rapidly whipped together the incision I had made into what proved to be the placenta, and then very quickly closed the abdomen tightly, without drainage.

The donor who had been present and given a pint of blood was still in the ante room; he was recalled and another 300 or 400 cc. taken and given to the patient.

At various times during the operation, after the bleeding stopped, she was pulseless, with no blood pressure. At the close of the operation, after having received the transfusion and 2,000 cc. of saline, her pulse had returned with some volume.

In all she received 1,000 cc. of blood on December 6th, 550 cc. on December 7th, and 460 cc. on December 8th.

At the time of her discharge from the hospital she was running a low grade temperature, 99° to 100°F. down in the morning and occasionally going several days without any fever. She was discharged to her home in the ambulance on December 24th, the wound clean and well healed.

About a week after her discharge she began to show signs of placental absorption and began to run a fluctuation of temperature; having a rather high afternoon temperature, with a low morning excursion. Her color became poor and it was soon evident that she was getting a tremendous disruption of her red blood cells from the toxicity of the absorbing placenta. She was readmitted to the hospital on January 8th with a red blood count of 2,920,000.

An endeavor was made by transfusion to keep her blood picture ahead of her destruction but this proved unsuccessful, so that in spite of her poor condition it was believed there was nothing else to do but to operate and remove the placenta. In spite of 2,000 cc. of blood her red count went to 1,870,000 and the hemoglobin to 37 per cent.

On January 15th, the abdomen was opened by a left rectus incision and a black, foul smelling, necrotic placenta was found which was adherent to the sigmoid, mesentery of the small bowel, and small bowel and uterus. Where the placenta was picked off the sigmoid, a hole was left about one and one-half inches in diameter and this was repaired with several layers of interrupted silk sutures. Five gm. of sulfathiazole were left in the cavity and two cigarette drains packed into the cavity. Her condition at the close of the operation was fair.

On January 16th, the red count had increased to 4,001,000 and the hemoglobin to 96 per cent. On January 17th, she was given 750 cc. of

blood. At this time she developed an edema of the lower extremities.

On January 18th, she showed evidence of a cardiac arrhythmia which responded to digifoline. The red count was 5,003,000 and blood chlorides 430 mg. She was given 250 cc. of plasma.

At times on doing the dressing there was a suggestion of a fecal odor, and on January 23rd a fecal mass about the size of an English walnut was removed. The discharge of fecal material gradually became less and on discharge from the hospital, March 8th, the fecal fistula was still present but very slight in amount, the wound granulating in nicely. She still had occasional edema of the left lower extremity and it was believed that there was some pelvic phlebitis which accounted for this condition. Her red blood count on discharge was 4,260,000 with a hemoglobin of 88 per cent.

In all, during this hospital admission, she received 750 cc. of citrated blood and 250 cc. of plasma.

She was seen at her home during the next two or three weeks. The fecal fistula practically closed and she was up and about, walking out of doors. The edema of the left leg was still present but not bothering her as much. She was eating well and her bowels moved normally. She had menstruated while in the hospital and continued to have normal periods after returning home. About the first week in May she returned to her work as a secretary.



# CONGENITAL TERATOMA OF THE THYROID\*

## CASE REPORT

PAUL W. SUTTON, M.D.

AND

EDWARD W. GIBBS, M.D.

Assistant Professor of Clinical Surgery, College of  
Medicine of the University of Cincinnati

Assistant Attending Surgeon,  
Cincinnati General Hospital

CINCINNATI, OHIO

TERATOMAS of the thyroid gland are of sufficient rarity to warrant the report of another case. In 1935,

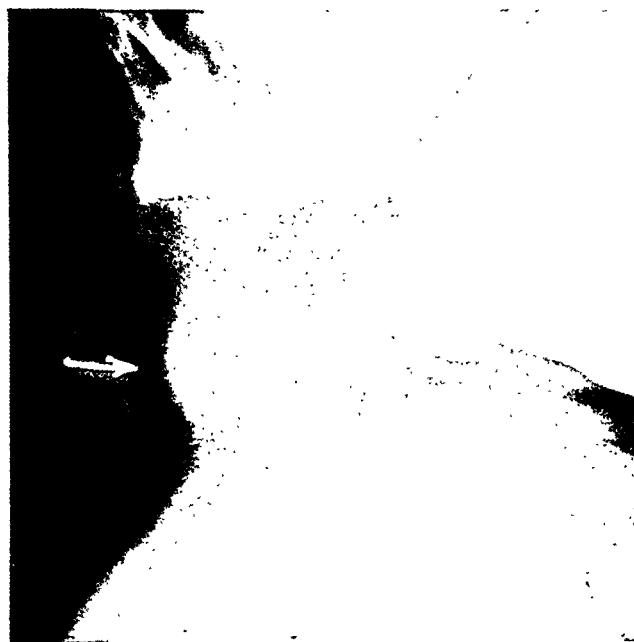


FIG. 1. Lateral x-ray film of neck showing relative size and location of tumor.

Pusch and Nelson<sup>1</sup> published a review of the literature and collected forty-three cases. However, fifteen of these had been described before the microscope was in general use; and although many of them were undoubtedly true teratomas, they could not be classified as such. The remaining twenty-eight cases were accepted as authentic and the authors added a case from their own experience.

In 1938, Potter<sup>2</sup> reported a similar case thus bringing to thirty the total number of histologically proved cases in the literature.

Boyd<sup>3</sup> defines a teratoma as "a tumor consisting of different tissues or organs

derived from more than one primitive germ layer." These lesions when found in the thyroid are usually in the lateral region of the neck. They frequently interfere with normal delivery of the fetus and many of the reported cases were found in stillborn infants.

The following case is a typical example of a teratoma of the thyroid. It does not demonstrate any features which have not been described but is of interest because it was surgically removed from a living infant and because it appeared clinically to be a midline tumor of the neck.

## CASE REPORT

J. L. J. No. 37743, a three months old female negro infant was admitted to the general surgical service of the Children's Hospital on November 27, 1942. The mother complained that since birth she had noted a mass in the infant's neck and that its respirations had been heavy.

The infant, the mother's first child, had been born at full term after two hours of labor. She was delivered spontaneously as a vertex presentation without complications. She had received only breast milk since birth without complimentary feeding. The child had suffered no illnesses and had received no immunizations. The family history was negative except for a goiter in the mother and epilepsy in a maternal cousin.

At birth the mother had noted a swelling in the neck which was about the size of a golfball. Since then it had always been present but had varied in size occasionally, at times becoming larger and at other times smaller. There was no history of inflammation in the area. The mother had noted also that the baby breathed noisily

\* From the Department of Surgery of the College of Medicine of the University of Cincinnati and the Children's Hospital, Cincinnati, Ohio.

MARCH, 1944

at birth and had continued to do so, especially when lying down. The child had taken its feedings well with no apparent dysphagia and no vomiting. The stools had been normal.

infant cried. The mass was fixed to the deeper structures of the neck but the overlying skin was normal and non adherent. The remainder of the physical examination was not remarkable.

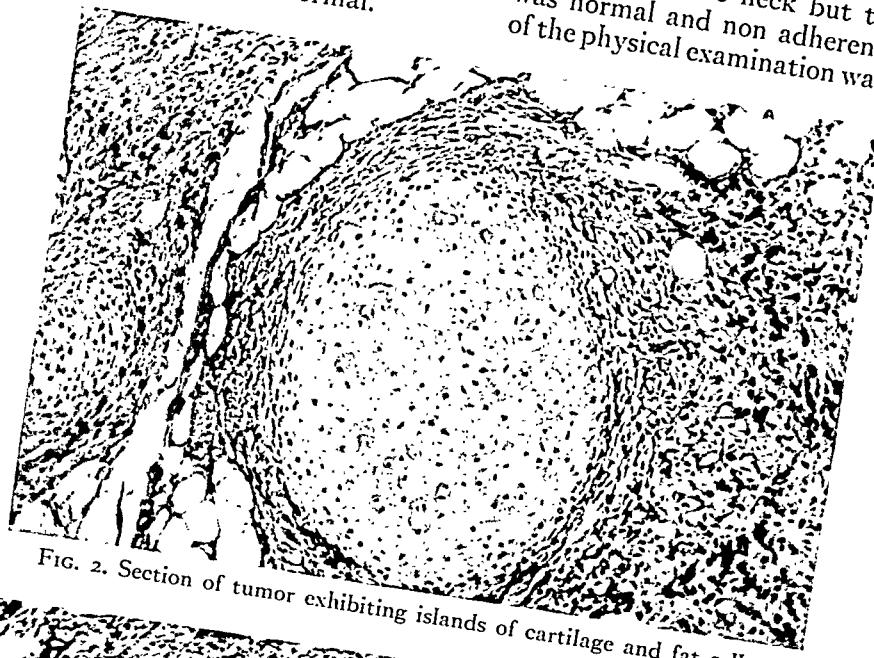


FIG. 2. Section of tumor exhibiting islands of cartilage and fat cells.

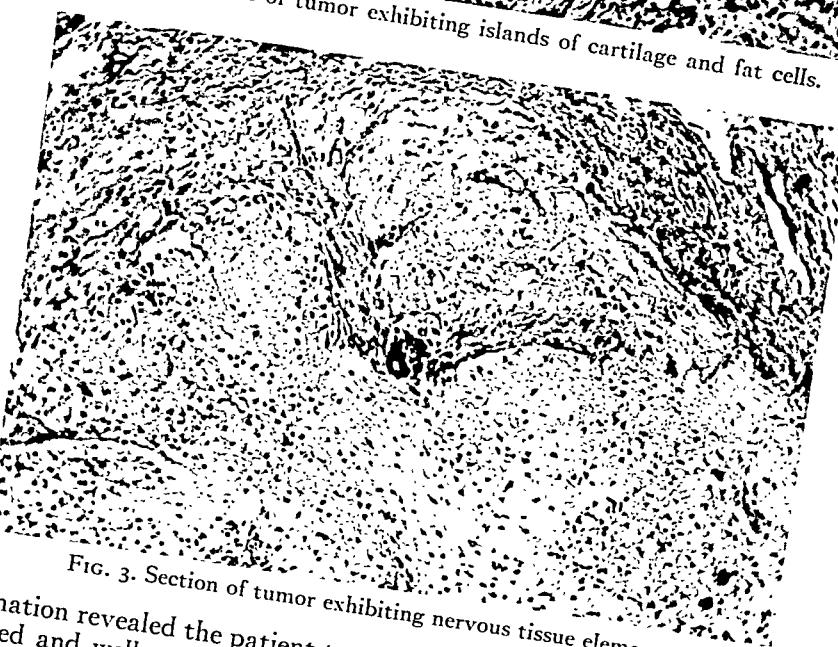


FIG. 3. Section of tumor exhibiting nervous tissue elements.

Physical examination revealed the patient to be a well developed and well nourished negro female infant, twenty-three inches in length, weighing twelve pounds eight ounces. There was a marked laryngeal stridor. In the neck was a smooth, firm, globular, non-tender mass which appeared to be in the midline and extended from the level of the hyoid bone to the suprasternal notch. The mass measured 5.0 cm. in maximum diameter. In some areas it felt cystic and it seemed to become tense when the

Laboratory studies were essentially normal. The erythrocyte count of the blood was 4,42 million, the hemoglobin 11.2 Gm. and the leucocyte count 8,100. The differential blood smear contained 68 per cent lymphocytes, 22 per cent polymorphonuclear neutrophiles, 9 per cent mononuclear cells and 1 per cent polymorphonuclear eosinophiles. The urine was negative. Blood Wassermann and Kahn tests were negative. Tuberculin tests were also negative.

Stereoscopic x-ray examinations of the soft tissues of the neck (Dr. H. G. Reineke) showed slight irregularity of the anterior tracheal wall due to pressure from an area of enlargement in the soft tissues. There was dilatation of the pharynx, suggesting a partial obstruction at the laryngeal level but no abnormalities were seen in the soft tissue immediately anterior to the spine.

The clinical diagnosis was tumor of the thyroid gland or thyroglossal duct cyst.

On December 3, 1942, the mass was removed at operation under endotracheal ether anesthesia. A transverse incision was made over the swelling in the neck. After reflecting the skin and platysma upward and downward, the underlying strap muscles were separated in the midline of the neck. Those on the right side were found to be stretched over the anterior surface of the mass and on reflecting them laterally the mass was found to lie entirely within the right lobe of the thyroid gland. It was well encapsulated and traversed by numerous small blood vessels. It was easily shelled out from its bed in the thyroid and had no direct communication with any structure other than the thyroid. After removal only a thin capsule of thyroid tissue remained to represent the right lobe. The left lobe and isthmus were normal. The wound was closed in layers with silk. It healed per primum and the infant was discharged from the hospital cured on December 16, 1942.

The pathologist's report (Dr. R. Johansmann) was as follows: "The gross specimen consists of a  $3 \times 4 \times 5$  cm. well encapsulated, lobulated tumor mass removed from the thyroid gland. The entire mass is composed of a large thick-walled cyst surrounded by a fibrous capsule. The wall of the cyst varies from 2 to 10 mm. in thickness. Masses of dense white tissue and light tan areas with tiny cysts are present in the wall. There is within the cyst and attached to it at several points, a large firm mass measuring about 3 cm. in diameter, which is composed of a light grayish white tissue spotted with light tan streaks, tiny chalky white spots, and larger, irregular, well outlined, grayish-blue, translucent islands of cartilaginous tissue. In the center of the growth there is a space,  $2 \times 5$  mm. which is filled with a clot of blood."

"Microscopic description: Microscopic examination reveals a well encapsulated growth composed of a conglomeration of tissue representing all three primitive germ layers. There are numerous small and large islands of cartilage which in some areas are undergoing calcification. There are a few masses of osteoid tissue which are being converted into osseous tissue. Masses of nervous tissue, consisting of glial cells and fibrils, are scattered throughout the growth. In the centers of these masses are gland-like spaces, lined by tall columnar cells, resembling neuroepithelium. The larger cysts, noted on gross examination, are lined by tall, columnar, glandular epithelial cells supported by connective tissue and surrounded by incomplete rings of smooth muscle tissue. Some of these cysts are lined by stratified squamous epithelium, sometimes markedly flattened, while other cystic spaces are lined by alternate masses of stratified squamous and columnar epithelium. Islands of adipose tissue are also present as are areas in which there is proliferation of vascular endothelium with the formation of numerous capillaries. The remainder of the growth consists of connective tissue which for the most part is of highly cellular collagenous type, but in some areas is of the myxomatous variety. Several glands lined by a low or tall cuboidal epithelium and filled with pale pink colloid are present in the fibrous capsule. There are no signs of malignancy. Diagnosis: Teratoma of thyroid gland."

#### CONCLUSIONS

A case is reported of congenital teratoma of the thyroid gland which was surgically removed from a three months old infant and is the thirty-first authentic case report in the literature.

#### REFERENCES

- Pusch, L. C. and Nelson, C. M. Congenital teratoma of the thyroid gland. Report of a case with a review of the literature. *Am. J. Cancer*, 23: 791, 1935.
- Potter, E. L. Teratoma of the thyroid gland. *Arch. Path.*, 25: 689, 1938.
- Boyd, W. *Surgical Pathology*, 5th ed., p. 151. Philadelphia, 1942. W. B. Saunders Co.



# INVERSION OF UTERUS\*

REPORT OF TWO CASES AND A NEW METHOD OF HEMORRHAGE CONTROL

WALTER A. NORTON, M.D.

Attending Surgeon, Warren A. Candler Hospital

SAVANNAH, GEORGIA

POSTPARTUM inversion of the uterus is a rare condition, but once seen can never be forgotten. So rare is it that

According to Crosse's statistics one-third died either at once or within a month of the accident.<sup>3</sup> In a certain number of

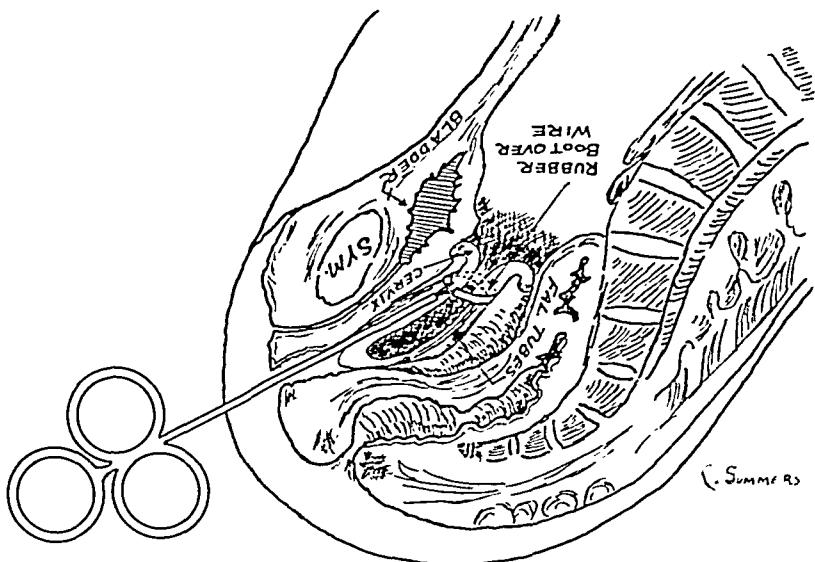


FIG. 1. Tonsil-otone with rubber tubing half around snare wire is pushed high over inverted fundus; when tightened it is a perfect rubber tourniquet.

one of the latest textbooks on obstetrics fails to mention it at all. So rare indeed is it, that Braun states that of 250,000 births in the clinics respectively under the charge of Spaeth and himself, not a single complete inversion came to their notice, and in the Rotunda hospital in Dublin, one case was seen in 160,000 confinements.<sup>1</sup>

Inversion may be complete or incomplete. Howard Kelly states that it is more frequent in multiparous women<sup>2</sup> and in those under thirty, and that it is always accompanied by profound shock, which may be out of all proportion to the amount of blood lost. Death often occurs promptly from hemorrhage and shock.

cases the inversion becomes a chronic condition; the patient by some miracle survives the shock, but continues to bleed from the exposed mucosa and becomes more and more anemic. Inversion comes on gradually, beginning as a little depression and then suddenly the fundus drops into the vagina, the patient utters a sharp cry and bears down. This bearing down has a tendency to increase the prolapse of the inversion.

De Lee describes the procedure of replacement as follows:<sup>4</sup> "After the whole hand, grasping the uterine body has replaced same in vagina, the constricting cervical ring is spread by means of fingers

\* Presented before the Georgia Medical Society, Savannah, Georgia, May 25, 1943.

and thumb, while the palm of the hand forces up the fundus," (the thumb bearing toward the bladder while the backs of the fingers bear towards the rectum) "the outside hand (above the pubis) aids in dilating the fundus. Begin with even compression of the mass for three or four minutes."

My experience in Case I convinced me beyond any doubt that replacement is a very difficult thing to accomplish and in some cases it is utterly impossible.

#### CASE REPORTS

**CASE I.** Mrs. H. G., age thirty-five, a multipara, was brought to the Savannah Hospital in July, 1925. She had been sent from a town sixty miles away in an ambulance, arriving at eleven o'clock at night. When she reached the hospital she was in profound shock and shock treatment was given by the resident physician, who then called me from my summer home twenty-four miles away. Arriving fifty minutes later, I was informed that she had been delivered at about seven o'clock in the evening, at which time the attending physician made a futile effort to reduce the inversion. When I reached the hospital the patient was already in the operating room and examination revealed a complete inversion of the uterus. An immediate effort was made under light ether anesthesia to reduce the inversion, but the patient died in less than thirty minutes. I did not accomplish reduction.

#### CLINICAL LABORATORY RECORD

##### BLOOD

Date.....	3/23/42.....	3/28
Red blood cells.....	.....	1,850,000
Hemoglobin.....	.....	20%
Color Index		58%
White blood cells.....	.....	9,600
Differential Count		
Myelocytes.....	.....	0
Young forms.....	.....	2%
Band forms.....	.....	4%
Adult polymorphonuclears.....	.....	67%
Total polymorphonuclears.....	.....	73%
Lymphocytes.....	.....	23%
Monocytes.....	.....	0
Eosinophiles.....	.....	4%
Basophiles.....	.....	0

**CASE II.** Mrs. L. H., age nineteen, a primipara, entered Warren A. Candler Hospital on March 22, 1942, with a history of delivery six months before at which time she had an inversion of the uterus. She was told by her physician

that it had been replaced, but she suffered from a constant uterine bleeding with the passage of many clots from then to the present time. On admission her hemoglobin was 20 per cent; pulse 120; blood pressure 110/80. Vaginal examination revealed the uterus to be inverted; the cervix was constricted by a band in top of the vagina; the uterine fundus was in the vagina, practically filling it; the endometrium was absent; the uterus bled easily when touched; the perineum was tight. (Table I.)

The vagina was packed with two-inch pack and sulfanilimide crystals and I ordered transfusions until hemoglobin reached 70. Vitamin K was given and extra nourishment, including liver extract and 200 mg. doses of thiamine chloride every other day; three transfusions of 500 cc. of citrated blood were given on alternate days. As the inversion had existed for six months it was manifestly impossible to accomplish reduction. On the fifth day after entering the hospital hemoglobin of patient was 60 per cent and I decided to operate.

Under ether anesthesia the tight perineum was incised and in order to perform a vaginal hysterectomy in this already depleted patient, and to avoid embarrassing hemorrhage, I used a tonsil snare in the following manner: (Fig. 1.)

A small rubber boot was fashioned to make a half circle on the snare wire so that when tightened the rubber protected wire would completely surround the uterus as near the constricted cervix as possible. (The bladder was not involved in the inversion.) When the snare was placed and tightened, I found that it not only acted as a perfect tourniquet, but also as a tenaculum and enabled me to pull the uterus well down and out, and with the electric cautery I quickly removed the fundus, with the loss of but a few drops of blood.

Because of the fact that the uterus had been inverted for six months with the tubes on a tight stretch, they were so atrophied that they appeared like jute hardware cord and they slowly retracted upward as soon as severed. I then sutured the stump, using a double running suture and gently pushed it up through the constricted cervix.

The patient made a smooth recovery, marred only by the development of a furuncle on the buttock, which was opened and drained on the fifth postoperative day. She left the hospital on April 6th, which was the fifteenth postoperative day.

## CONCLUSION

I have briefly described a condition rare in obstetrics. It is probable, however, that it occurs much more often than has been recorded. In Case I, a complete inversion, reduction was impossible, even though the patient reached the hospital only a few hours after the inversion occurred. In Case II, a chronic inversion, with the fundus in the vagina, the patient responded to operative treatment in which a tonsil snare

covered with rubber tubing was used to control hemorrhage. I recommend this simple method for use in similar cases.

## REFERENCES

1. LUSK. Science and Art of Midwifery. P. 607. D. Appleton Co., 1896.
2. KELLY. Operative Gynecology. Vol. 2, p. 897. D. Appleton Co., 1908.
3. CROSSE. An essay, literary and practical, on inversio uteris. *Tr. Pror. Med. & Surg. Ass.*, page 344, 1847.
4. DELER. Principles and Practice of Obstetrics. 7th ed. p. 898. W. B. Saunders Co., 1939.

25-125

TORSION of the splenic pedicle sometimes occurs in the wandering organ. The torsion may be acute or chronic, acute cases presenting the symptoms of an intra-abdominal catastrophe. Chronic torsion may result in atrophy of the spleen, and after a period of indefinite abdominal discomfort all symptoms abate.

# ABSENCE OF HALF OF THE LEFT DIAPHRAGM\*

## CASE REPORT

MILLARD S. ROSENBLATT, M.D. AND

Assistant Professor of Surgery,  
University of Oregon Medical School

J. B. BILDERBACK, M.D.

Professor of Pediatrics,  
University of Oregon Medical School

PORLAND, OREGON

**C**ONGENITAL diaphragmatic hernia is a not uncommon lesion in infancy. It can be readily diagnosed. It can be successfully treated by transabdominal

The report of this case is occasioned by the unusual defect present. No previous report of a successfully treated defect of this nature is known to us.



FIG. 1. Stomach filled with barium shown in left thoracic cavity.

approach. The discussion of this entity by Ladd and Gross† cannot be improved upon and should be read by any one interested in the subject.

†LADD and GROSS. Abdominal Surgery of Infancy and Childhood.

\* From the Departments of Surgery and Pediatrics, University of Oregon Medical School and Doernbecher Hospital.

## CASE REPORT

This two-month old white male entered Doernbecher Hospital on August 14, 1942. This child had a depressed sternum and very rapid breathing, both of which were noted since birth. The child had to be fed small amounts at



FIG. 2. A considerable portion of the large bowel is in the left thoracic cavity. The opaque shadow seen there turned out to be spleen.

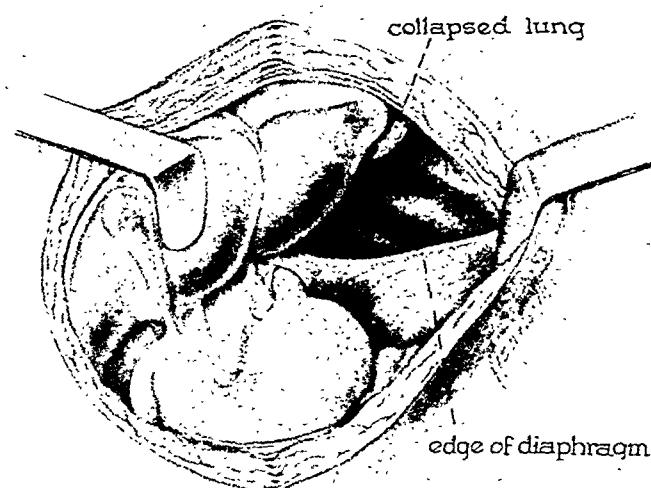


FIG. 3. Congenital absence of portion of diaphragm; appearance at operation.

frequent intervals, about two ounces every two hours. If fed larger amounts cyanosis developed.

The patient's temperature was normal. He

barium meal. The heart was deviated to the right so that it lay almost entirely to the right of the dorsal spine. The stomach was displaced

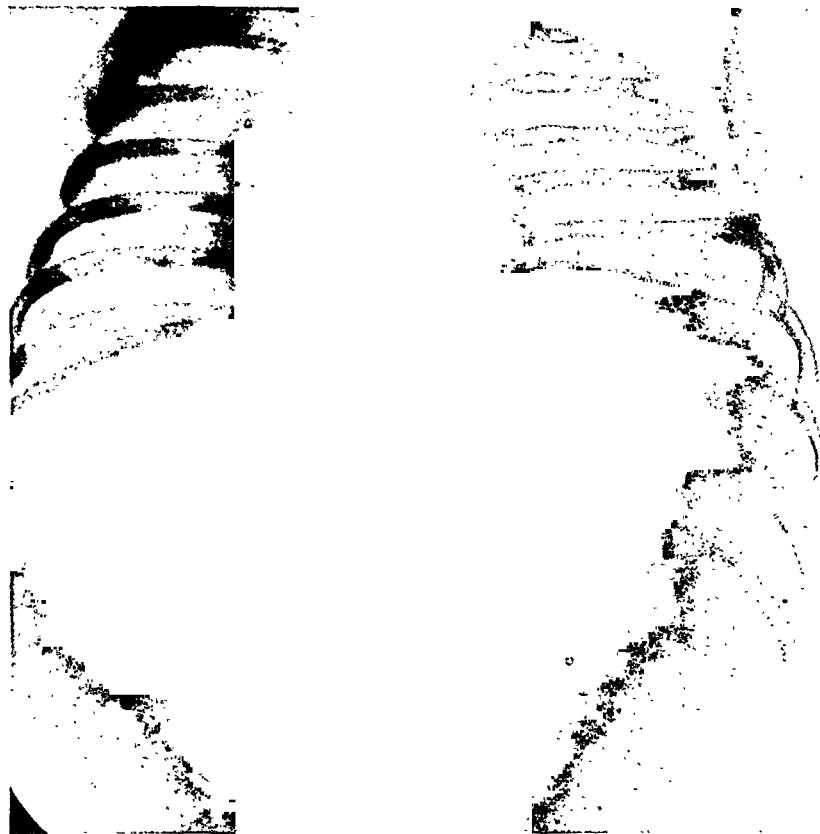


FIG. 4. Postoperative view. The lung has re-expanded; the heart is still considerably displaced; the edge of the diaphragm is clear and although higher than normal appears to have separated the thoracic and abdominal cavities.

was a moderately well developed, well nourished white male. There was very marked retraction of the sternum in the region of the xiphoid. Respirations were shallow and quite rapid, and on visualization something seemed to be radically wrong with the child's breathing. Despite this the color was good. The child appeared very frail. Essential findings were confined to the chest. There was apparent heart shift to the right. Heart sounds were not audible in the left chest. There was tympany with absence of breath sound over the left chest posteriorly. However, there was normal lung resonance with breath sounds audible in the apex of the left chest. The right chest revealed normal lung resonance with normal breath sounds throughout. The liver extended 4 cm. below the right costal margin. Otherwise the abdomen was negative.

Urinalysis, hematology, and sedimentation rates were normal. Blood serology was negative. An x-ray of the chest was taken after

upward into the left chest. The distal end of the esophagus was in the normal position. The barium enema revealed prompt filling of the colon, the splenic flexure of which was displaced into the left chest cavity.

From our findings and observations in this case, we believed that there was a definite herniation of abdominal viscera into the left chest cavity pushing the heart to the right and compressing the left lung. The child was prepared for operation. He was given nothing but saline by mouth. Twenty-four hours prior to the operation he received 10 per cent glucose in normal saline, 20 cc. per kilo, intravenously. In a few hours he received 80 cc. of human serum intravenously. Also he was given 150 cc. of Ringer's solution subcutaneously to secure good hydration. Blood for transfusion was secured.

Prior to operation the stomach was emptied by lavage. A continuous intravenous drip was started by cutting down on the vein, tying

needle into the vein, whereby he received 10 per cent glucose in distilled water throughout the operation. On August 20, 1942, he was given a general ether anesthesia and incision was made over the left clavicle. The left phrenic nerve was isolated and crushed. The abdomen was entered through an upper abdominal left rectus muscle splitting incision. The stomach, spleen, large bowel, and a good portion of small bowel were withdrawn from the left chest cavity. It was then found that the entire anterior portion of the left diaphragm was absent. The edge of the posterior half of the left diaphragm was sutured to the anterior abdominal wall and the anterior chest wall with interrupted cotton sutures. The defect was thus closed. The abdominal contents were able to be restored to the abdominal cavity without too great increase of intra-abdominal pressure. The abdominal wound was closed. The child withstood the procedure well but was immediately placed in an oxygen tent where he remained for six days.

During the first postoperative day the child had transient attacks of cyanosis and dyspnea. However, from the second postoperative day on the course was uneventful. Small feedings were started on the third postoperative day which were retained. The formula then was gradually increased until he was taking a

normal feeding. Two transfusions of 80 cc. each were given. The continuous intravenous drip was discontinued on the third hospital day. Hydration was then maintained by subcutaneous fluid and by mouth. On September 3rd, x-ray of the chest revealed the heart was displaced to the left to a more normal position. There was a greater expansion of the upper portion of the left lung. Air could be identified in the stomach which was in a normal position. The abdominal viscera were seen to extend upward to the sixth rib posteriorly. The lung markings were seen to extend down to the eighth rib. In the lateral view, the left diaphragm was seen to rise posteriorly to the level of the fifth dorsal vertebra.

The baby has been followed at intervals and the lung has re-expanded and the abdominal viscera have remained below the diaphragm.

#### SUMMARY

A case of a two months' old baby with absence of half of the left diaphragm is reported. Satisfactory separation of the pleural cavity from the peritoneal cavity was established by suturing the edge of the posterior half of the diaphragm to the chest and abdominal walls.



# ESOPHAGEAL VARICES

## CASE REPORT

BERNARD WELT, M.D.

AND

SIMON R. BLATTEIS, M.D.

Associate in Ear, Nose and Throat Surgery,  
Jewish Hospital

Consulting Physician, Jewish Hospital

BROOKLYN, NEW YORK

HERE are two theories explaining the etiology of esophageal varices: One is that they are caused by a disturbance of the vascular regulating mechanism of the spleen and the other by an obstruction in the splenic or portal vein. The patient had no splenic anemia, but a portal block due to scar tissue formation following a liver infection secondary to acute peritonitis and appendicitis.

Crafoord and Frenckner, of Stockholm, as reported by Herman J. Moersch, of the Mayo Clinic, were the first to report the successful use of sclerosing solution for esophageal varices. Moersch reported eleven such cases. These men devised special instruments for this procedure. The writer used an ordinary esophagoscope with a metal suction tube attached to a tonsil needle to inject the sclerosing solution.

The patient had received twenty-four transfusions and it was believed that these transfusions merely replaced the lost blood. It was becoming increasingly difficult to replace this loss. This case report is presented not only to add another successful case to the literature, but also to show that the injection of a sclerosing solution through the esophagoscope in cases of esophageal varices may at times be a life-saving procedure.

### CASE REPORT

D. P. No. 232282, a fifty-year old, white male, was admitted to the Jewish Hospital of Brooklyn, on March 25, 1942, with the chief complaint of hematemesis. He gave a past history of having been operated upon for appendicitis in 1936, with a stormy and prolonged hospital stay (163 days), due to develop-

ment of multiple liver and intra-abdominal abscesses postoperatively. He underwent six operations during his stay and finally recovered. He then felt well until May 10, 1940, a period of about three years, when he had his first attack of hematemesis. He was hospitalized for eight days, during which time investigation resulted in a diagnosis of esophageal varices due to pyelophlebitis. This was verified by x-ray. The next episode of hematemesis occurred in October, 1940, when patient was again hospitalized and a transfusion of 500 cc. of citrated blood was given.

Since that time, the patient had had occasional episodes of tarry stools and hematemesis. He received treatment for anemia from his family physician. In the three days prior to this admission, the patient had two bouts of hematemesis. Because of a feeling of weakness and a drop in systolic blood pressure to 80 he was hospitalized.

Physical examination revealed a well developed and well nourished white male, with marked pallor; blood pressure 115/70. There were no abnormalities noted. Scars of previous operations were well healed and firm.

At 11 P.M., March 25, 1942 on the day of admission, the patient vomited 700 cc. of bright red blood. He became cold and clammy; his pulse was rapid and of a poor quality, and blood pressure was unobtainable. The patient was placed in the Trendelenburg position and warmth, nasal oxygen and continuous intravenous fluids given. Transfusion was ordered. Hemoglobin was 30 per cent. On March 26th, at 1 A.M. a transfusion of 500 cc. of citrated blood was given. At 12 noon, the patient vomited one liter of blood. At 1:45 P.M., a transfusion of 500 cc. of citrated blood was given; hemoglobin was 52 per cent. At 10:30 P.M. the patient vomited 900 cc. of bright red blood. On March 27th at 12:30 A.M. a transfusion of 500 cc. of citrated blood was given rapidly. The patient was in shock and was

comatose; the pulse was barely perceptible. At 1:30 A.M. another transfusion of 500 cc. of citrated blood was given. Blood pressure was 100/40, pulse of fair quality. At this stage a surgical consultation was deemed advisable (Dr. Paul Aschner). At this consultation the history was again reviewed and the x-rays restudied. The consultation confirmed the diagnosis of esophageal varices resulting from interference with venous circulation complicating previous intra-abdominal disease. Two courses of treatment were possible: either the passing of the esophagoscope and attempt to control the bleeding by electrodesiccation or the injection of sclerosing agents into the varicose veins. At 1:15 P.M. a transfusion of 500 cc. of citrated blood was given. At 6:30 P.M. patient vomited 800 cc. of bright red blood and had a bloody (frank blood) bowel movement. Patient complained of pressure-like, precordial pain, probably due to cardiac anoxemia resulting from a low hemoglobin (40 per cent); temperature 103°F. At 7:45 P.M. another transfusion of 500 cc. of citrated blood was given.

On August 28th, at 2:30 A.M. a transfusion of 500 cc. of citrated blood was given. At 7 A.M. he vomited a small amount of blood. The patient was receiving intravenous fluids and nasal oxygen. At 9:30 A.M. another transfusion of 500 cc. was given; hemoglobin was 40 per cent. At 5:15 P.M. he had two tarry stools and vomited a small amount of blood. Another transfusion of 500 cc. of citrated blood was given. His temperature was 103°F., no blood pressure was obtainable. At 7 P.M. the pulse was weak and thready; blood pressure was 70/40. Another transfusion of 250 cc. of citrated blood was given at 9 P.M.

On April 2nd, his condition somewhat worse. The patient continued to spit up blood and pass bloody stools. Hemoglobin was 32 per cent, temperature 100.4° to 101°F. The patient received five more transfusions. Abdominal distention now appeared. He was seen by Dr. Blatteis who thought that the prominent abdomen was due to edema of parietes and not to free fluid in the peritoneal cavity. There was also some subcutaneous edema along the posterior chest. No pleural fluid was present. Fluids were restricted and no saline in any form was to be given. The patient did not vomit that day.

On April 8th, vomiting and passing of blood per rectum had recurred. He received five more

transfusions; hemoglobin 32 per cent, temperature 101°F. Dr. Blatteis stated that bleeding from the esophageal varices seemed to come in form of continuous oozing. Transfusions merely replaced loss of blood and it became increasingly difficult to supply or replace the loss; other measures indicated for the profound anemia were being employed. It was argued that the varices were not due to the cirrhosis of the liver, but rather to interference with the venous circulation from the many adhesions, bands, etc. which must have resulted from the numerous operations. The prognosis was exceedingly grave.

On April 10th, the patient's condition was not very favorable; hemoglobin was 29 per cent. The patient was taken to the operating room for esophagoscopy. At the lower third of the esophagus the lumen was about two-thirds obstructed by five or six rather large, tortuous varicosities. The largest of these were at 12 and 6 o'clock, respectively. Through a No. 25 tonsil needle, 2 cc. of sodium morrhuate were injected at 12 o'clock. This was followed by a gush of blood. The patient withstood the procedure fairly well. Postoperatively, a transfusion of 500 cc. of blood was given.

On the following day, bleeding had ceased. He was comfortable, complained only of slight soreness on swallowing; hemoglobin was 35 per cent.

On April 14th, bleeding has not recurred; hemoglobin was 43 per cent. Esophagoscopy was again performed. Varicosity at 12 o'clock was much smaller and blanched in appearance. Varicosity at 6 o'clock seemed to be fused with varicosities at 7 o'clock and was markedly dilated in appearance. This vein was then injected with 2 cc. of sodium morrhuate. No reaction of note occurred. Postoperatively, a transfusion of 500 cc. of citrated blood was given.

Two days later his condition continued to improve and there was no further bleeding. A transfusion of 500 cc. of citrated blood was given; hemoglobin was 54 per cent.

On April 21st, hemoglobin was 61 per cent. His condition was markedly improved and he was esophagoscoped again. Varicosities were smaller, even those which were not injected. Marked pulsations were noted in one, which apparently overlay the aorta and this was injected with 2 cc. of sodium morrhuate. This was followed by a gush of blood on withdrawal. A transfusion of 500 cc. of blood was given.

It was believed by the writer that no further therapy was indicated as the patient was not bleeding any more.

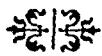
On April 28th, hemoglobin was 65 per cent. There was no evidence of bleeding. The stools were brown in color and hemoglobin was increasing. Pulse was 96 and lungs were clear. Abdominally, the spleen was 4 cm. below the costal arch; the liver could not be made out; the abdomen was soft with no tender points. The general condition of the patient was highly satisfactory, both mentally and physically. With the exception of a secondary anemia none of the other collateral evidences of his condition

were observed. He was discharged greatly improved.

On March 15, 1943, the patient was seen by the writer. He states that no vomiting of blood had occurred since the last esophagoscopy. He did, however, have an episode of nasal bleeding from the right nasal vestibule that was easily controlled by application of local cautery. He continues actively at work and considers himself in good physical condition.

#### REFERENCES

1. MOERSCH, HERMAN J. *J. Thoracic Surg.*, 10: 300, 1941.
2. MOERSCH, HERMAN J. *Ann. Otol., Rhinol. & Laryngol.*, 50: 1233, 1941.



MEDICAL treatment sometimes relieves symptoms, but never removes stones from the gall bladder. Unless there is some definite contraindication to operation the correct treatment for stones in the gall bladder is cholecystectomy.

# TREATMENT OF FRACTURE OF ASTRAGALUS BY INTERNAL FIXATION WITH METAL PIN

## CASE REPORT

DAVID O. WEINER, M.D.\*

ST. LOUIS, MISSOURI

**R**EPORTS on the treatment of fractures of the talus are confusing and indefinite. Although several

tempts to reduce the fracture by the closed method failed to produce adequate apposition of the fragments.



FIG. 1. X-ray of ankle showing fracture of talus and the anterior lip of tibia.

authors, Olivecrona,<sup>1</sup> McWhorter,<sup>2</sup> Key and Conwell,<sup>3</sup> Miller and Baker,<sup>4</sup> Speed and Smith,<sup>5</sup> Boyd and Knight,<sup>6</sup> and Schrock, Johnson, and Waters,<sup>7</sup> advise internal fixation in cases in which anatomical apposition of fragments cannot be obtained by the closed method, many others are pessimistic about the end results; some even advise arthrodesis and astragalectomy (Cole and Elman,<sup>8</sup> and Steindler<sup>9</sup>). The purpose of this paper is to report a case in which internal fixation of a fracture of the body of the astragalus was accomplished with a Kirschner wire with a good end result after several at-

## CASE REPORT

R. L. H. a twenty-one-year old white soldier, while on duty slipped and fell from a height of sixty feet landing on his feet. He experienced excruciating pain in the right ankle immediately on striking the ground. He was brought to the hospital about two hours after sustaining the injury. Medical history was entirely negative except for the complaint involving the injury to the right ankle and foot. General physical examination on admission revealed a well developed and nourished white male, conscious, rational, and not in shock or acute distress. There was a great deal of ecchymosis, marked swelling, and tenderness

\* Dr. Weiner is now a Major in the Medical Corps, U. S. Army.

present over the right ankle. X-ray of the right ankle revealed a fracture of the body of the astragalus just beyond the neck running

layers. (Fig. 2.) A plaster of paris cast was applied extending from the toes to the knee.

The postoperative course was uneventful. A



FIG. 2. Postreduction film showing Kirschner wire in place.

downward and backward to the posterior facet of the calcaneus. The fragments were separated and the anterior fragment raised so that it impinged on the anterior surface of the tip of the tibia where a small fragment was chipped off but only slightly elevated. (Fig. 1.) Laboratory studies of blood and urine were not remarkable. Because of marked swelling and ecchymosis about the right ankle it was decided to delay manipulation of fragments. The leg was placed in a bivalved cast. Eight days after injury was sustained the swelling had diminished sufficiently to warrant attempting to reduce the fracture by the closed method, but this was to no avail. Due to injury to the skin about the ankle during manipulation it was necessary to delay open operation an additional eight days.

Under spinal anesthesia using 150 mg. of procaine a two and one-half-inch incision was made on the dorsomedial aspect of the right foot, just below and in front of the medial malleolus. After approximating the fragments a Kirschner wire was driven into the neck and directed backward and laterally. About  $3\frac{1}{2}$  cm. of the wire was driven into the body of the astragalus and then x-ray was taken to check the position of the wire. The wire was then cut flush at the neck and the wound closed in

walking caliper was applied to the cast two weeks after operation and the patient allowed to walk. The cast was removed seven weeks after operation and the patient started to walk with the aid of crutches one week later. There was gradual return of motion at the ankle and by the ninth week the patient started bearing weight on the ankle. Rehabilitation of the involved ankle and foot was progressive with subsequent discharge to field duty on the eleventh week when he had approximately 50 per cent function of the ankle. Because the soldier was unable to carry on with full duties in the field he was returned for reclassification. A letter from him one month later stated that he was given a sick furlough from a General Hospital at the termination of which he would return to field duty. Further he stated that he still walked with a slight limp and had occasional pain in the ankle. The patient wrote this message twenty-one weeks after date of injury.

#### SUMMARY

A case of a fracture of the body of the astragalus of the right ankle, treated by internal fixation with a Kirschner wire and followed for a period of five months

after operation, is presented. The availability of the material for the type of operation described above makes it a simple procedure and can be used in combat zones as well as in civilian hospitals. It is believed that fractures of the body of the astragalus which cannot be reduced by the closed method should be treated by open reduction and internal fixation.

## REFERENCES

1. OLIVECRONA, H. Considerations on treatment of fractures of astragalus. *Acta chir. Scandinav.*, 62: 353-357, 1927.
2. McWHORTER, GOLDER L. Open operation for fracture of the astragalus with displacement. Good

results two years later. *Surg. Clin. North America*, 12: 1230, 1932.

3. KEY, JOHN ALBERT and CONWELL, H. EARLE. The Management of Fractures, Dislocations, and Sprains. St. Louis, 1937. C. V. Mosby Co.
4. MILLER, OSCAR LEE and BAKER, LENOX DIAL. Fracture and fracture-dislocation of the astragalus. *South. M. J.*, 32: 125-136, 1939.
5. SPEED, J. S. and SMITH, HUGH. Emergency treatment of fractures and fracture-dislocations of the ankle. *Am. J. Surg.*, 46: 700-710, 1939.
6. BOYD, H. B. and KNIGHT, R. A. Fractures of astragalus. *South. M. J.*, 35: 160-167, 1942.
7. SCHROCK, R. D., JOHNSON, H. F. and WATERS, C. H. JR. Fractures and fracture-dislocations of talus. *J. Bone & Joint Surg.*, 24: 560-573, 1942.
8. COLE, WARREN H. and ELMAN, ROBERT. Textbook of General Surgery. New York, 1936. D. Appleton-Century Co.
9. STEINDLER, A. On fracture deformities of the ankle. *Mississippi Valley M. J.*, 61: 195-202, 1939.



IN early cases of peritonitis, if the focus of infection be removed the abdomen often can be safely closed without drainage. The capability of the peritoneum to overcome a certain amount of infection is truly remarkable.

The brief excerpts in this issue have been taken from "A Short Practice of Surgery" by Hamilton Bailey and R. J. McNeill Love (H. K. Lewis & Co. Ltd.).

# Bookshelf Browsing

## EVOLUTION OF BONE GRAFT SURGERY

FRED H. ALBEE, M.D.

NEW YORK, NEW YORK

THIRTY-FIVE years ago, the writer published his first original use of the bone graft in arthodesing the hip joint, and it is now over twenty-six years since he set himself to the task of writing the first book published in any language upon the sole subject of Bone Graft Surgery.

Seven years before this, in 1908, he was unable to induce Dr. Alexis Carrel to settle for all time, by animal research, whether the detached autogenous bone graft would uniformly live and prove to be a dependable surgical agent for surgical bone reconstruction. Fortunately, for the writer's enlightenment, Dr. Carrell was so busy with his world famous chick heart work that he could not turn aside to do the bone graft research. Therefore, from necessity, it was decided that he use his evenings and nights and do the work himself, and fortunately, because of his occupying the Chair of Orthopedic Surgery at Cornell University Medical College at that time, ample facilities at the Loomis Laboratory and Animal Hospital on East 26th Street, New York City, were available.

Of the great variety of research on dogs done during those years, the fusion of the dog's spinal column by a free graft from his own leg was the most outstanding. One important principle was proved in the very beginning, and that was the untrustworthiness of heterogenous grafts—bone grafts from sheep when implanted into dogs and vice versa. The bone graft was always found to be demarcated from the surrounding bone by a cavity filled with serous fluid.

The encouragement from these most gratifying results led to the writer's immediately starting the fusion of the human spine for tuberculosis and various other reconstruction work by bone graft, which has continued with increasing success during the past thirty-five years. (Fig. 1.)

Over this extensive span of years, the trustworthiness and dependability in a wide variety of such work has been amply proved in clinical practice. Bone graft operations were then relatively few but have since been adopted by the surgical profession the world over in various classes of cases otherwise considered hopeless.

It has been most gratifying to the writer during this period to observe in his extensive travels the constantly increasing surgical uses of the bone graft. These travels have consisted of twenty-four visits to Europe since 1909, to every State in this country and Canada, to every country in Central America, the Antilles and every country in South America, excepting one.

The author's original technic of bone transplantation, although fundamentally unaltered since the early days of its inception, is being utilized today in an ever increasing variety of ways for the cure of disease and numerous examples of derangements of the bones and joints. The reparative influence of the bone graft enables the reconstruction surgeon to keep pace with the unfortunate sequelae of industrial and road accidents. The therapy of congenital absence of such bones as the radius, tibia and fibula, as well as congenital non-union can now be undertaken

with greater assurance than was possible heretofore. The Albee bone graft spine fusion operation has rendered the treat-

The graft has been of no less usefulness in successful arthrodesing, without exception, all other tuberculous joints by extra-

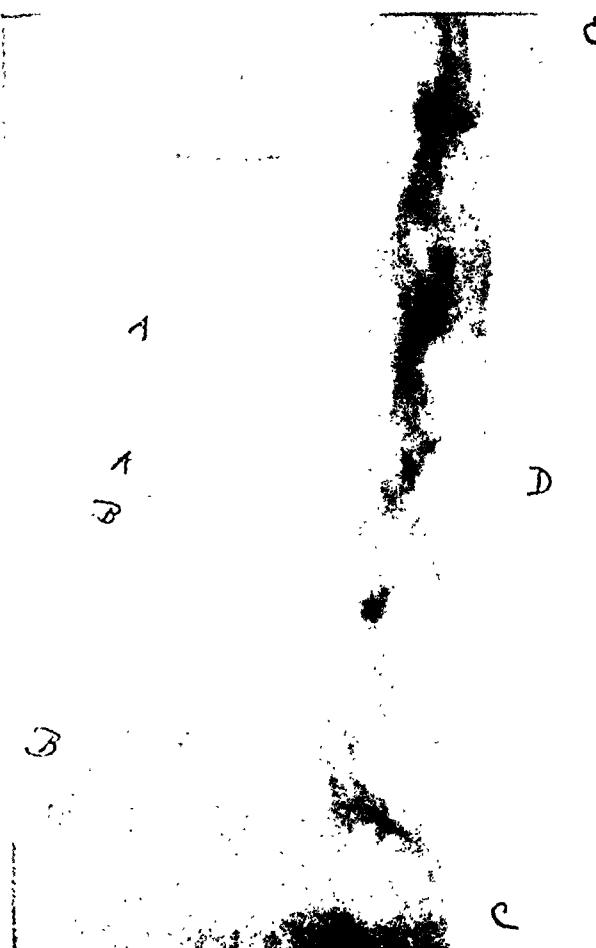


FIG. 1. Case V. D. Roentgenogram showing excellent spine fusion for acute Pott's disease of lumbar vertebrae twenty-six years after implantation, at different times, of two tibial inlay bone grafts *cc*, fused to each other at *b*, as well as into the lumbar spine, for two foci of acute tuberculosis in the vertebral bodies at *AA* and *BB*. This case was complicated by a tuberculous epididymitis. The first spinal operation was performed when the child was five years of age, and the subsequent one eight months afterward. Later the patient became a seaman and engaged in the most strenuous type of activity. It should be noted that there has been a complete healing of the tuberculous processes with firm fusion of the vertebral bodies themselves.

ment of a wide variety of affections of the spine less formidable, including Pott's disease, vertebral fractures, congenital malformations, scoliosis, (Fig. 2A, B, and C), spondylolisthesis, and diseases of the sacroiliac joint.

or intra-articular methods (1919) (Figs. 3 and 4.) In congenital dislocation of the hip in which, because of shallowness of the acetabulum, the femoral head will not remain in place, the bone graft has made possible the deepening of the hip socket by

the so-called "shelf" operation (1915). If, because of structural shortening or other causes, it is impossible to bring the femoral

teres was ruptured at the time of fracture, which has been proved a very frequent occurrence. The autogenous peg is also the



FIG. 2A. Case E. P. Idiopathic scoliosis. Corkscrew spine after prolonged unsuccessful treatment by corrective exercises, braces, plaster jackets and traction.

head downward to the acetabulum, the bone graft has made it possible to erect a shelf-acetabulum over it on the side of the ilium at its most favorable site.

The bone graft peg is believed to be the ultimate solution as primary treatment of those cases of central fracture of the neck of the femur (1913), when the ligamentum

method of choice in non-union of the hip; and if the degree of femoral neck absorption prohibits the use of the peg, the removed femoral head modeled to a wedge serves to reconstruct the hip and restore its kinesiology (1919). The author, in 1908, was the first to offer an operation for arthrodesis of advanced osteo-arthritis

(senile coxitis) and other conditions. In fact, the bone graft is an important feature in procedures for ankylosing all joints for a

nant bone tumors and immediate restoration of the involved portion of the skeleton by transplanted bone has marked

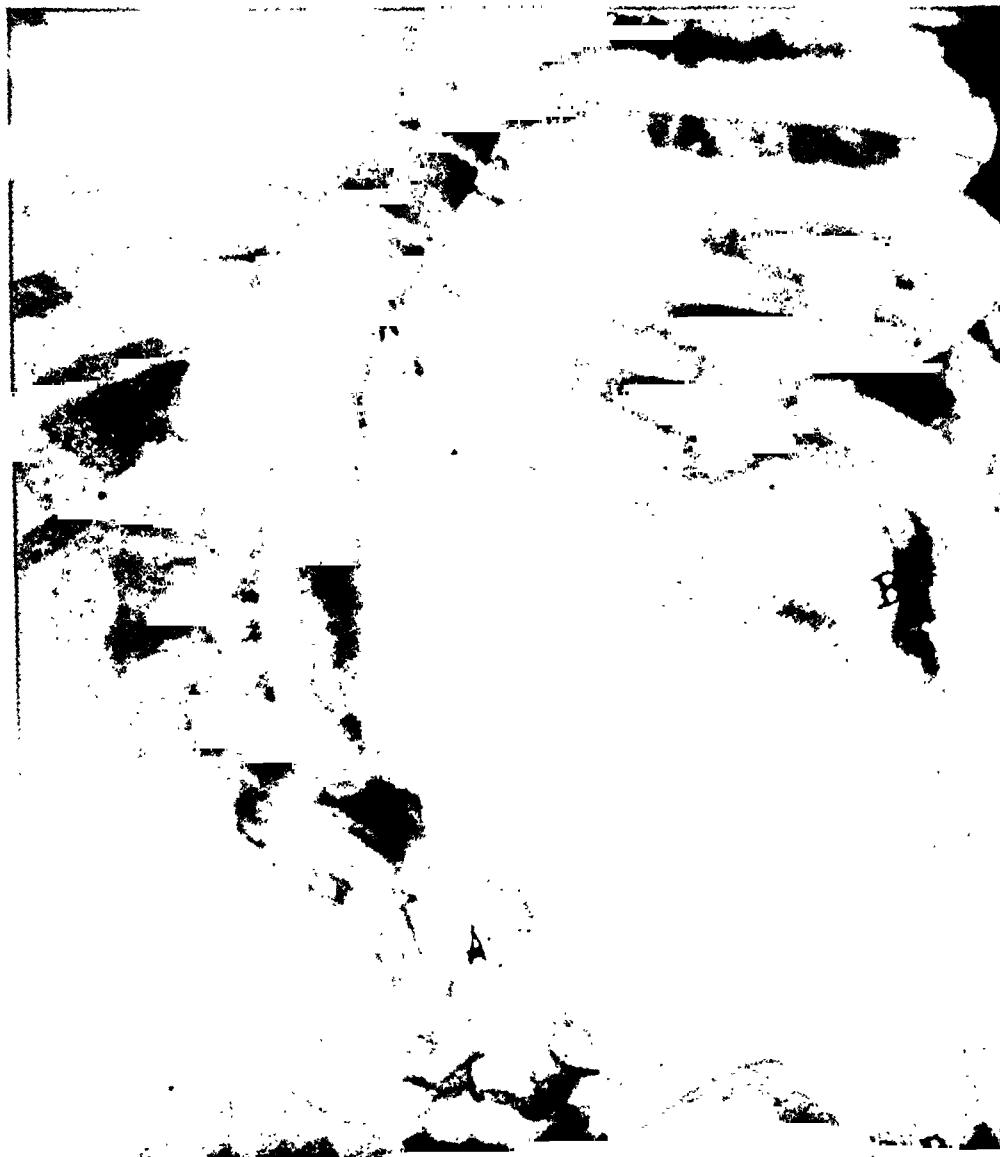


FIG. 2n. Case E. P., X-ray of Figure 2a, four years after implantation of grafts in accordance with schema (Fig. 2c) showing particularly the prop graft at  $\text{nn}$  holding securely the corrected position of ribs after they were extracted from within the pelvis at operation. The graft is firmly united with the tenth rib and pelvis at  $\text{nn}$ . Note increased diameters and density of tenth rib, also hypertrophy of spinal graft at  $\text{aa}$ . This is because of the biological reaction to the laws of stress (Wolff's law). Full correction was not attained because of extreme contracture of soft tissues on concave side following extended conservative therapy. This patient now indulges in the most strenuous of exercises, including skating and tennis.

multitude of conditions. Replacement of congenital absence of bone such as the radius, ulna, tibia or fibula, has been made possible.

The radical massive resection of malig-

a new achievement for the man who does bone surgery. (Figs. 6a, b and c, and 7a, b and c.) In fact, the author's statistics of selected cases done by him during a period of twenty-one years, shows that although

limbs are saved by such methods, still the risk to life is no greater than when the limb is sacrificed by amputation. The ravages of

from infantile paralysis, nerve involvement of the corda equina of the spinal cord and other nerve injuries, old local muscle de-

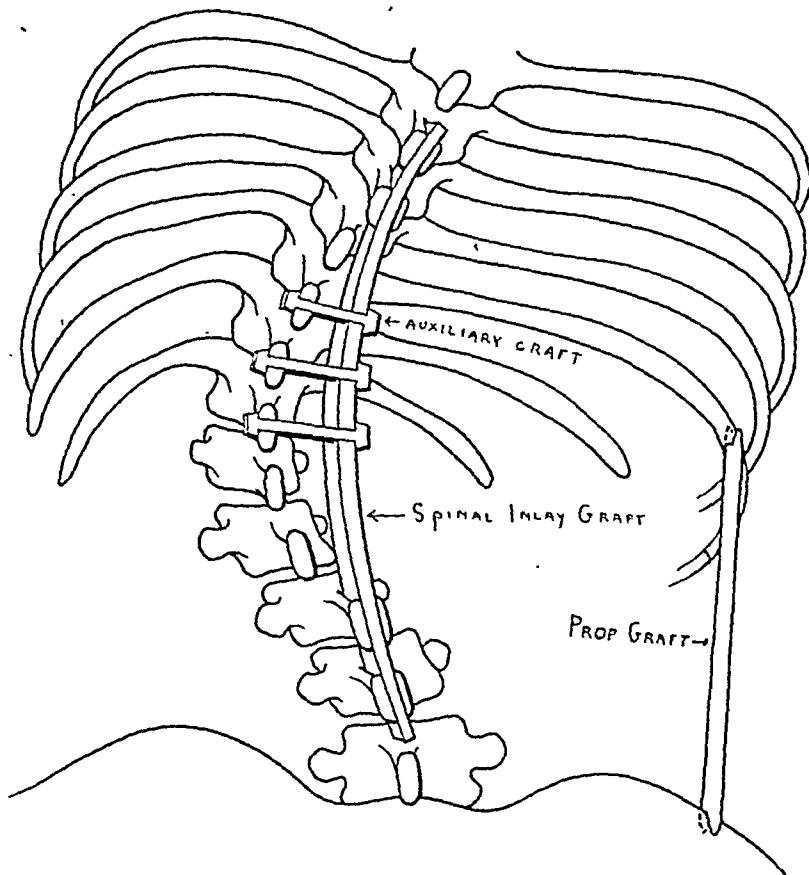


FIG. 2c. Schematic representation of prop graft. (Fig. 2b.) Note interlocking of graft and tenth rib, also auxiliary grafts at right angle to spinal graft where it is impossible to mold the graft to a sufficient curvature.

poliomyelitis have been tempered by the judicious application of arthrodesis and bone graft block operations. The limitations of tendon transplantation are becoming more clearly defined and a greater reliability reposed when associated with stabilization and reconstruction kinesiologic operations upon the skeleton. The most recent contribution of the author in this field is concerned with the partially paralytic hip, for which he has devised a method to elongate the kinesiologic lever at the top of the femur for the purpose of obtaining a more stable hip and a stronger weight-bearing limb. The functional strength of the weakened abductor weight-bearing muscles is increased by lengthening the bony lever which they pull upon. Such muscle weakness has resulted

struction, etc. The operation, possible because of the bone graft, has also been found to be effective in a number of other conditions in which the lever has been shortened, namely, in epiphysitis of infancy, etc., destruction from tuberculosis, congenital dislocation (Fig. 5A and B), insufficiency of the trochanter following arthroplasty and non-union of the hip with absorption of the femoral neck.

The query must thus be made, why is it possible to bring about results in cases otherwise hopeless by this radical departure from older surgical procedures?

The principal reasons are: First, the development and the availability of the x-ray; second, the perfection of the small universal electric motor, and consequently the electrically driven bone mill; third,

the fracture-orthopedic traction operating table, and last, the proof of the dependability of the survival of autogenous bone

of itself to another as well as from one element or part of the skeleton to another. This is best demonstrated by the case of the



FIG. 3. Case N. H. Tuberculosis of the right hip. Failing to yield to long conservative treatments, it was cured by extra-articular tibial bone graft fusion at *a* and *b*.

transferred for any reparative purpose from one part of the body to another. The evolution of a surgical armamentarium for cutting and modelling hard bone approaching the precision and rapidity of operation of power-driven precision tools of the machinist or cabinetmaker has played the most important rôle. The advantage of this is because of biophysiological requirements.

It should be realized from the outset that the method is revolutionary in that repair, reconstruction, changing of outlines and architecture and the changing of the kinesiologic mechanism of the skeleton has been for the first time made possible.

These hitherto impossible accomplishments have been made possible because transferred living bone tissue becomes a part of the osseous system wherever it has been implanted. This transplant takes on all the functions of supporting living tissue; it serves to convey vessels from one portion

FIG. 4. Same case as Figure 3. Four years after cure by bone graft fusion, and one year and two months after arthroplasty securing approximately 50 per cent of motion at hip by the incomplete removal of graft at *a* (Fig. 3) and leaving large portion of graft at *b* (Fig. 3) as a kinesiologic lever to stabilize by the attached muscles the active function of the newly made joint. The modelling of the new joint is shown at *c*.

synthetic construction of a digit of the hand, when bone grafts of as much as four and one-half inches in length have been inserted into a boneless finger made up of recently transplanted skin and subcutaneous tissues obtained from the abdomen or elsewhere. Nerve supply extends to the tip of such constructed digits in about one year. Such cases have been observed by the writer over periods of more than twenty years, including x-rays and histopathological examinations. These grafts increase in size and strength in accordance with functional demands and co-ordinately with the necessary increase of number and size of inherent blood vessels in the interior of

the graft itself. This has been shown by repeated x-ray and pathological examinations. The phenomenon of tissue survival

because of trauma or disease, blood is needed at a remote portion of a bone, whether it be a part of the skeleton or

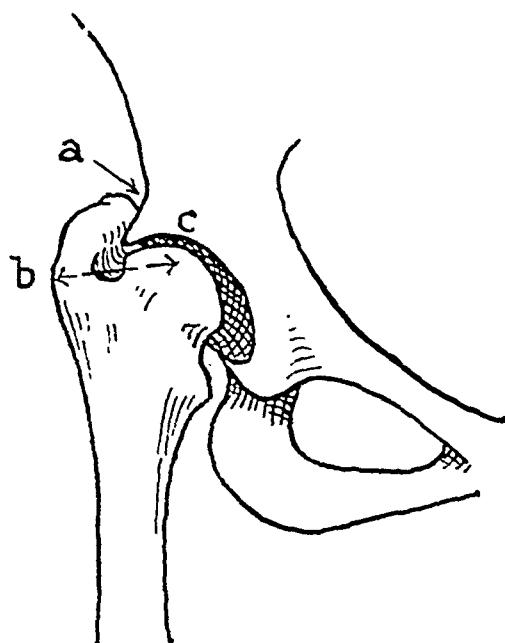
FIG. 5A<sub>1</sub>.

FIG. 5A.



FIG. 5B.

FIG. 5. Case S. K. A, roentgenogram and accompanying schema (Fig. 5A<sub>1</sub>) showing marked congenital shortening of the kinesiological lever with a pronounced bone block to abduction at A in a case of congenital dislocation of the hip long after its reduction. B, a very recent roentgenogram showing postoperative result in the same case as Figure 5A. The bone block has been moved and the lever has been markedly lengthened by displacement of the greater trochanter outward. A rectangular graft from the outer table of the ilium of the same side has served to hold the trochanter in its outward position as well as to fuse it to the upper portion of the femur.

and growth demands this. It is merely a part of the biophysiology of living bone in its growth maintenance and repair. If,

bone graft, nature provides a collateral circulation to bring blood from another part of the same bone.

This property of the graft is extremely important in its surgical applications to the cure of disease or in various problems of

graft itself, blood from the vascular trochanter region to the anemic capital fragment and to the fracture junction.

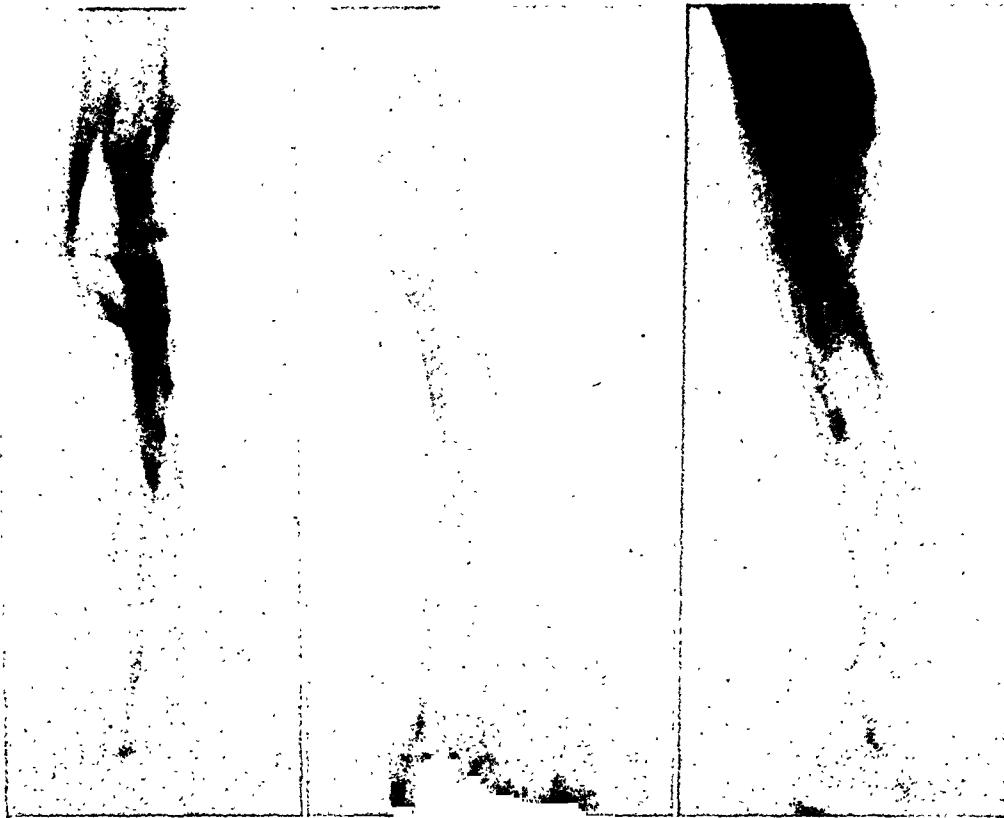


FIG. 6. Case B. S. Malignant osteochondrosarcoma of the right femur. Resection of one-third of lower portion of femur leaving condyles of the femur. A, three months after bone graft operation. The shaft was resected, but the epiphyseal cartilage was left intact. B, four months after operation showing extensive enlargement of bone graft and callus deposition. C, complete restoration of the shaft of the femur two years after operation. It is now seven years, lacking two months, since the operation, and there has been no evidence of local recurrence or metastases. Note diameter of bone graft equals normal diameter of femur with marrow cavity developed through it.

bone repair, such as spinal tuberculosis, or un-united fracture of the neck of the femur. In the first instance, it serves besides immobilization and mechanical support, to conduct blood from the posterior cancellous part of the healthy vertebrae on either side of the disease over to the diseased anemic portions of the vertebral bodies.

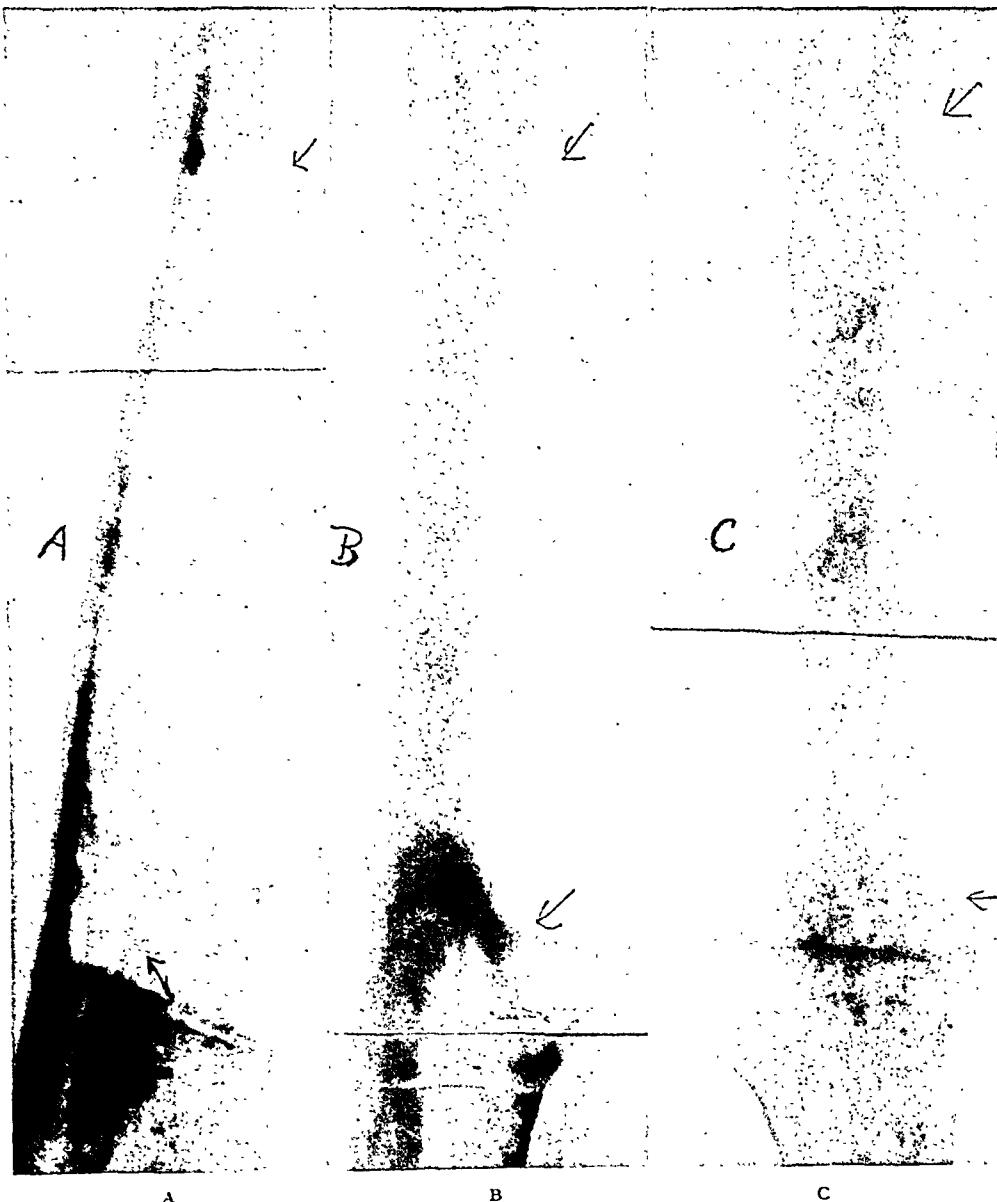
In the second instance, the sizeable bone graft peg serves: First, to immobilize the subcapital fracture of the neck of the femur; second, to bring or stimulate callus formation, or osteogenesis to the fracture junction; and last but not least, to convey by collateral circulation, developing in the

The writer has found that in non-union of this fracture coming to his reconstruction operation with removal of the femoral head, the ligamentum teres (the sole remaining source of blood supply to the capital fragment) has been torn or destroyed in 98 per cent of cases at the time of fracture.

The principles of grafting living tissues are exemplified in their simplest form in plant grafting. One can safely assume that the principles of plant grafting cannot be violated in the grafting of tissues of a higher form; and that grafting of bone cannot be as readily carried out as grafting of vege-

table material. These postulates arise from the very nature of biological principles and the decrease in adaptability with

These principles are important but not as necessary in bone grafting. In fact, there is a close biologic parallel between wood and



**FIG. 7.** Case S. K. Osteogenic sarcoma of the lower end of the femur involving the condyles of the femur and necessitating the removal of the knee joint as well as over one-third of the lower shaft of the femur. **A**, x-ray taken immediately after resection and replacement by tibial bone graft. **B**, lateral x-ray view taken two and one-half years after operation. **C**, anteroposterior view taken two and one-half years after resection and replacement by bone graft showing that the graft has reached the diameter of the shaft of normal femur which shows in the upper portion of the x-ray. This x-ray also shows the development of a marrow cavity through the bone graft itself. It is now seven years since resection of malignancy and there is no recurrence or evidence of metastases.

increase in specialization of tissue. There are three inviolable rules in plant grafting: The tissue must be applied like to like; the contact must be most intimate; and they must be immobilized in that position.

bone in that they are both supportive tissue, and although one is of the vegetable and the other of the animal kingdom, they both present identical response to the laws of stress.

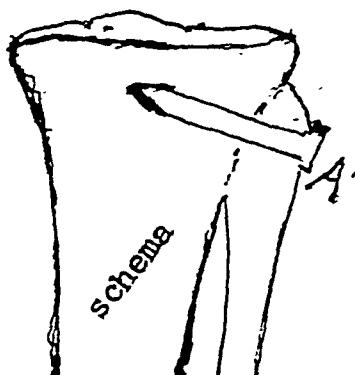


FIG. 8B1.

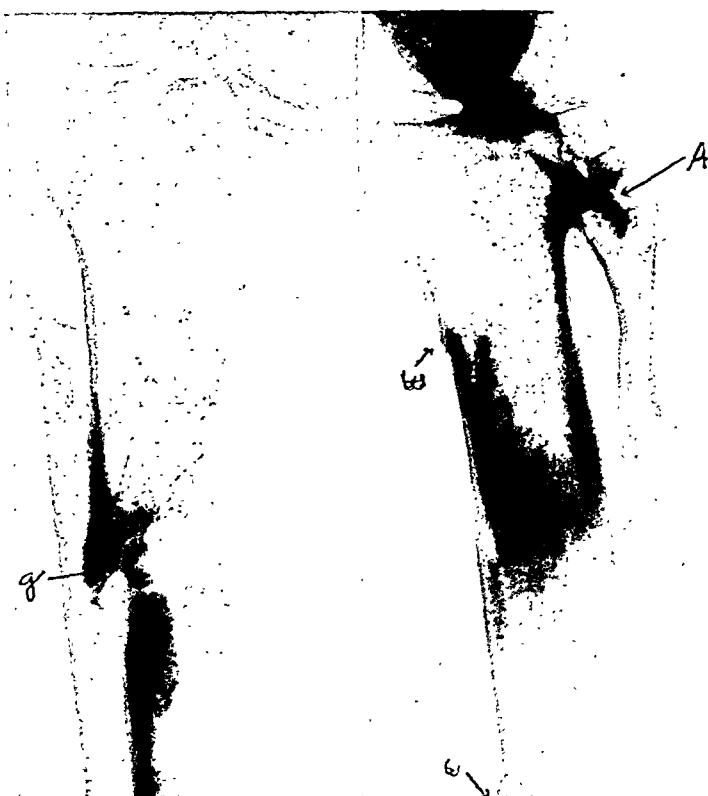


FIG. 8A.

FIG. 8B.

FIG. 8. A, This is the case of a famous polo player who came to the author after having been treated unsuccessfully at many clinics for five years for pseudoarthrosis and osteomyelitis. Roentgenogram shows ununited fracture of the upper third of the tibia with loss of bone. g, Shows sequestrum which was removed and wound healed by the use of bacteriophage. B, this x-ray shows same case as Figure 8A after cure of osteomyelitis and the securing of union by means of inlay bone graft B in tibia, and fusion of tibiosfibula joint with bone graft peg at A. In the treatment of ununited fractures in the upper end of the tibia, the author has for many years used, as a supplementary supportive measure, fusion of the tibiofibula joint.

Precisely as Sandow's bones increased in diameter, weight and strength because of the increased mechanical demands of stress

the sap must permeate the cells of the scion or the latter will eventually die. In bone, reestablishment of the blood circulation



FIG. 9. These three x-rays illustrate the case of a child suffering from healed osteomyelitis with subsequent loss of bone which was restored by bone graft. A, shows extensive loss of tibial bone at AA. B, shows replacement of this loss of bone at BB. C, shows the hypertrophy of the graft at CC with its diameter the same as the rest of the tibia. This lateral view shows a marrow cavity developed through the graft.

coming to them from muscular development, or the reverse influence from infantile paralysis, so does the living wood tissue respond to increased stress. The bone graft responds in exactly the same way. They are both supportive tissues. (Figs. 6, 7 and 9.)

The re-establishment of the circulation is simpler in the plant, but it is obvious that

becomes a problem, the solution of which governs the whole question of surgical technic.

Immobilization is affected in plant grafting in two ways: In addition to the fixation provided by the accurate inlay fit of the scion, the junction of grafting is either bound with many layers of fabric or is covered with wax, or better, paraffin. These

sealing substances serve as a sterile dressing as well since they keep out fungi. If paraffin is used, immobilization is just as secure, and light (especially the ultra-violet) is allowed to permeate to the wounded tissues and especially to the bud which needs the ultra-violet for the metabolic activity of its chlorophyll.

Plant grafting and bone grafting thus have the same objective and are carried out according to the same fundamental principles. The application of these in bone must be more meticulous since there are added difficulties in a relatively highly specialized tissue nourished by a system of closed vessels.

In the plant, the graft and host tissues must be maintained in close apposition; other than this, the only displacing force to be counteracted is that of the wind, and this is only when the scion is a large shoot. In bones, there is danger from the motion of the recipient patient, the pull of muscles, both tonic and voluntary, and the exaggeration of the former by reflex from pain. Fixation and immobilization, therefore, present difficulties which must be met in a special way.

Bancroft's statement in regard to union of fresh fracture is even more applicable to the union of the bone graft: "The most important factor for the union of a fracture is to have the fractured ends in close apposition and to have an adequate blood supply to allow the ingrowth of granulation tissue with the resultant ossification to form callus."

Adequate blood supply and coaptation are even more necessary in the case of the graft applied to chronic cases, because the stimulus to osteogenesis which comes to a recent fracture is lacking in the old fragments. Again, in the fresh fracture, there is usually an adequate supply of blood in marked contrast to the ischemic state of pseudarthrosis. Union of the graft, therefore, proceeds under difficulties that must be counterbalanced by the most careful methods to secure ample blood supply in its application as well as in the method chosen.

#### VASCULARIZATION AND LIFE OF THE GRAFT

When the writer was in England in 1929, Sir Arthur Keith, the eminent clinical pathologist showed him specimens of grafts inserted for various purposes, which he had obtained from postmortems and injected to demonstrate the marked vascularization which always occurs in a graft that has well taken.

The early and complete vascularization of a graft has been very striking and interesting to the writer since his early animal experimental work in 1909, and he believes it to be one of the underlying causes of the extremely beneficial action of the bone graft, when inlaid in the spine, or through other tuberculous joints, such as the knee, the tarsus, etc. This factor emphasizes the importance of accuracy of fit of the graft to host tissues, and particularly to the vascular portions of them, and also the importance of using a massive graft of ample length, as under such condition the intact, unbroken Haversian canals of the graft very rapidly become canalized and increased in size in precisely the same way as a collateral circulation is established when demands for blood occur for tissue maintenance or repair when blood vessels have been destroyed.

The various layers of a bone graft freshly removed present raw surfaces wherever they have been cut. The vessels are severed but still contain blood which tends to clot at the point of section. The various tissues of the graft are capable of survival for a considerable time, but it is of the first importance to restore its blood supply and nutrition at the earliest possible time. The graft must be placed in the most favorable environment for this end. If it is so placed, the elements of the graft (periosteum, cortex, endosteum and marrow) make direct and intimate contact with similar elements in the host; the soft tissues of the bone first unite across the slight gap; vascular continuity of host and graft is re-established through periosteum, endosteum and marrow, and a granulation tissue bridge is laid

down between the bony surfaces. Osteoblasts appear in the granulation tissue and determine the deposition of lime salts. If the process follows Bancroft's picture of healing bone, the continuity of the Haversian systems will be indirect until the normal architecture has been established between the graft and the host. Under ideal conditions, the greatest possible number of capillaries of host and graft are brought into the closest mutual approximation. The entire graft will then remain intact. If such conditions are not provided, smaller or larger areas of the graft will fail to be nourished and will ultimately be replaced. The process by which the bony structure of the graft is later rearranged to conform to architectural structure of the host is, in no sense, absorption. The process can be called assimilation, if the term is used in the sense that the graft assimilates itself to the host. The graft is not the subject of processes imposed upon it by the host; it is itself the active agent in its own rearrangement under the influence of the stresses which it encounters in its new environment; it has the power of adaptation. The question of whether the bone graft lives, when properly placed in a favorable environment, has been answered positively in the affirmative during the past thirty-five years of personal experience, both in the animal research laboratory and in the clinic, at the operating table and the follow-up of over 6,000 cases. The x-ray is by all means the most trustworthy method of study, not even excepting the microscope. With its aid, the welfare and development of a graft over many years may be followed. Both in the case of animal work as well as clinical, if, for any reason, part of a graft becomes dead as from infection, the x-ray never fails to disclose it. There could never be any doubt about the continued life of a scion, such as in the apple tree. A scion from a sweet apple tree when grafted into a tree bearing sour apples will always bring forth sweet apples of the exact variety of the tree of the scion's origin. This same phenomenon occurs

throughout the vegetable kingdom so long as scions are grafted into one of its own family.

If all the elements of the graft cannot be brought into contact with similar elements of the host, the marrow at least should be. Johnson's conclusion that the circulation in a bone is re-established 75 per cent by the marrow and endosteum, and 25 per cent by the periosteum, indicates the shares which each tissue has in osteogenesis, and the importance of coaptting the graft with the marrow, or better, with both endosteal and periosteal side of the bone cortex. (Fig. 8A and B.) It is apparent that the inlay type of graft brings about these desired conditions as no other type does. The blood supply is the key to the situation, as shown by numerous clinical observations.

#### RELATION TO COAPTION TO UNION

The approximation of graft to host is analogous to closure of a wound in soft tissue. If the opposing surfaces are poorly approximated, much granulation tissue is required to fill the gap and healing is slow. If the surfaces are brought into close contact, the layer of granulation tissue is of small thickness and healing by first intention results. This speedy granulation tissue union not only re-establishes the circulation in the graft at the earliest moment, but results in the deposition of the thinnest possible layer of callus between the bones. This necessitates the least possible rearrangement of the callus trabeculae. It is thus evident that not only the viability of the graft but the promptness and durability of union and the rapidity of assimilation of the graft to the host tissues depend on close approximation of graft to both host bones. In non-union, the surgeon will find that nature has little callus for him and he must make the most of the meager supply; he must draw on mechanical principles to compensate for the meagerness of the physiological reaction.

When a graft containing all four elements is placed in intimate contact with the

same elements in the host, it acts as a vascular and osteogenetic unit; vascular union proceeds along the lines of natural repair and a bridge is placed between the two fragments which calls for the minimal amount of trabecular and vascular readjustment to be taken on the function of the host bone it replaces. If the graft is inserted or attached in any other way, vascular communications are limited and the graft may have to be largely or entirely reconstructed by nature before it assumes the structure suitable to the stresses exerted on it. It is, under such circumstances, that fracture or absorption may occur.

#### RELATION OF IMMOBILIZATION TO UNION

When soft tissues are uniting, their flexibility minimizes the danger of disruption of the granulations. When such rigid tissue as bone is uniting, the least displacement may tear the granulations and blood vessels, or fracture the soft callus. Hence, the necessity for the most precise and stable immobilization. From the mechanical standpoint, the advantages of "internal" immobilization needs no corroboration. Here again, the inlay graft is superior; it exemplifies the mechanical principle of the slot and key. (Fig. 8A and B.)

When the healing fragments and the graft are thus held in rigid immobility, the granulations and callus are protected not only between graft and host, but between the two host fragments. The stress of maintaining immobility should fall on the graft, and, under this influence, the graft grows in size and strength, and adapts its structure to the stress. Because of its phenomenal adaptation, a graft—the size of a pencil—when inserted to take the place of a portion of the femur, will grow to the dimensions of the host bone and assume a similar structure.

#### NECESSITY FOR POWER-DRIVEN TOOLS

The entire process of union and the survival of the graft depend on the establishment of vascular connections between

the graft and the host fragments. The rapidity of establishment and the degree and permanence of vascularization vary directly with closeness of coaptation and the rigidity of immobilization; these depend largely on accuracy of fit. The necessity for the greatest precision in the mechanical procedures needs no further argument; ideal conditions can be produced in no other way as well as by the use of automatic power-driven tools which can be adjusted to cut, with mathematical exactness, both the graft bed and the graft which is to fill it with a "glass stopper" precision fit. (Fig. 8A and B.) This is true whether the graft has the shape of a peg, screw, wedge, straight or mosaic inlay, etc. Fortunately, all bones are filled with cancellous tissue or marrow and are thus well suited to the inlay technic.

#### RELATIONSHIP OF MECHANICAL, PHYSIOLOGICAL AND BIOLOGICAL PRINCIPLES

The most unfortunate and the most general misconception of the treatment of non-union is that it is solely a mechanical problem. The idea is inherited from the principles of the treatment of fresh fractures. The traditional methods are based entirely on mechanics: how to overcome distorting forces and how to maintain alignment by the application of counter forces or stress.

If, after reasonable reduction and ample immobilization of the fragments, union fails, the problem passes from the realm of pure mechanics into those of physiology and biology. It is not to be expected that repetition of mechanical methods will be successful, since the stimulus to repair, to granulation and ossification has abated. Even in the open treatment of non-union, this faulty conception is frequently evident. Methods are commonly practiced which have no other basis. And there are surgeons who apparently believe that two pieces of bone must unite if held together and that the method of approximation, and means of maintaining them and availability of

blood supply have no bearing on the success of the operation.

In one case that came under my observation, the surgeon had begun by plating the fragments. When failure by this method was evident in due course, he used wire; after another disappointment, he resorted to nails. The third failure did not, by any means, shake his confidence in purely mechanical means. With a persistence, worthy of better cause, he put all three back at a fourth operation, plates, wire and nails. Four times over a period of three and one-half years did he try to find a mechanical antidote for the particular case. He did not fail for lack of skill as the wound healed each time by first intension; if applied to a piece of furniture, his repair would have outlasted the original.

I have tried to trace the reparative processes following the introduction of the bone graft, from the formation of granulation tissue to the incorporation of the graft as an integral part of the host tissue. We know that all tissue reacts to changes in environment. A fractured bone manifests the greatest reparative power during the period immediately following the injury. Since injury thus stimulates repair, it is clear that the freshly removed graft has potentialities for repair that will become fully manifest as soon as it can establish its vascular connections. This reaction to environment takes the form of increased metabolism. As the graft takes on its function of immobilization, its metabolism is further stimulated by the demands of its environment. The adaptive response is increased in size and strength, and this is just what occurs. Thus function determines structure and modification of function brings about modification of structure.

#### REFERENCES

- ADAMS, WILLIAM E. Craniocle with report of two cases repaired by bone graft. *Am. J. Surg.*, 31: 68; 1936.  
 AMERICAN ORTHOPEDIC ASSOCIATION. First Report of Fusion Operation of Spine, May 15, 1911.  
 ALBEE, FRED H. Experimental study of the bone growth and the spinal bone transplant. *J. A. M. A.*, April 5, 1914.

- ALBEE, FRED H. Original surgical uses of the bone graft. A report of 250 cases. *Surg., Gynec. & Obst.*, June, 1914.  
 ALBEE, FRED H. Bone Graft Surgery. Philadelphia, 1915. W. B. Saunders Co.  
 ALBEE, FRED H. Bone Graft Surgery in Disease, Injury and Deformity. New York, 1940. D. Appleton Century Co.  
 ALBEE, FRED H. The improved Albee bone mill. *Am. J. Surg.*, 39: 657-660, 1938.  
 ALBEE, FRED H. and KUSHNER, ALEXANDER. Albee spine fusion operation in the treatment of scoliosis. *Surg., Gynec. & Obst.*, 66: 979, 1938.  
 ALBEE, FRÉD H. Arthritis deformans of the hip joint: report of a new operation. *J. A. M. A.*, 50: 1553, 1908.  
 ALBEE, FRED H. Case of ununited fracture of the neck of the femur 3½ months' duration in woman of sixty years: case report. *Murphy's Surg. Clin.*, 3: 423, 1913.  
 ALBEE, FRED H. Treatment of nonunion with or without loss of bone. *Military Surgeon*, 87: 6, 1936.  
 ALBEE, FRED H. Restoration of shoulder function in cases of loss of head and upper portion of humerus. *Surg., Gynec. & Obst.*, 1: 19, 1921.  
 ALBEE, FRED H. The treatment of primary malignant changes of bone: by radical resection with bone graft replacement. *J. A. M. A.*, 107: 1693-1698, 1936.  
 ALBEE, FRED H. and WEIGEL, E. P. Restoration of loss of bone (including an analysis of the first hundred cases of fracture treated by bone graft at U. S. General Hospital No. 3, Colonia, N.J.) Read before the Congress of the Italian Orthopaedic Assn., Bologna, Oct. 18, 1919. Reprinted *J. A. M. A.*, 74: 589-597, 1920.  
 ALBEE, FRED H. Synthetic transplantation of tissue to form new finger (with restored function of hand). *Ann. Surg.*, April, 1919.  
 ALBEE, FRED H. Plastic repair of the lower jaw in ununited fractures with or without loss of bone. *Surg. Clin. North America*, 2: 301, 1923.  
 ALBEE, FRED H. Maldevelopment of the mandible treated by onlay bone graft. *Arch. Surg.*, March, 1928.  
 ALBEE, FRED H. Enlargement of the parturient canal by bone graft. *Surg., Gynec. & Obst.*, pp. 845-846, June, 1928.  
 ALBEE, FRED H., and SELDIN, H. M. Fractures of the Mandible. *Dental Cosmos*, 76: 4, 1934.  
 ALBEE, FRED H. Arthrodesis of the shoulder. *Surg. Clin. North America*, p. 439, April, 1925.  
 ALBEE, FRED H. Extra-articular arthrodesis with autogenous bone graft. *Surg., Gynec. & Obst.*, 43: 393-395, 1926.  
 ALBEE, FRED H. Bone graft wedge in the treatment of habitual dislocation of the patella. *Med. Rec.*, August 14, 1915.  
 BANCROFT, F. W. Process of union after fracture. *Ann. Surg.*, vol. 90, 1929.  
 BRADFORD, E. H., and LOVETT, R. W. Treatise on Orthopedic Surgery. New York, 1911. Wm. Wood Company.  
 BUNNELL, S. Physiological reconstruction of a thumb after total loss. *Surg., Gynec. & Obst.*, 39: 259-274, 1924.

- CALVÉ-JACQUES. Sur une forme particulière de pseudo-coxalgie greffée sur des déformations caractéristiques de l'extrémité supérieure du fémur. *Rev. de chir.*, 62: 54-84, 1910.
- CAMPBELL, WILLIS C. A Text Book on Orthopedic Surgery. Philadelphia, 1930. W. B. Saunders, Co.
- CAMPBELL, WILLIS C. Central or intrascapular fracture of the neck of the femur. *Proc. Calif. Acad. Med.*, p. 53, 1931-1932.
- CAMPBELL, WILLIS C. Operation for the correction of drop foot. *J. Bone & Joint Surg.*, 21: 4, 1923.
- CAMPBELL, WILLIS C. Bone blocks for paralytic feet. *Am. Jl. Surg.*, July, 1927.
- DILGER, F. G. A new operation for producing anterior or posterior bone block of the ankle. *Am. J. Surg.*, 43: 532-533, 1939.
- GAENSLEN, F. J. Arthrodesis. *J. A. M. A.*, December 10, 1927.
- GIRDLESTONE, G. R. The operative treatment of Potts' paraplegia. *Brit. J. Surg.*, 19: 121-141, 1931.
- HIBBS, R. A. Treatment of vertebral tuberculosis by fusion operation. *J. A. M. A.*, 71: 1372, 1918.
- HIBBS, R. A. and RISSER, J. C. Scoliosis treated by the fusion operation and end-result study of 360 cases. *J. Bone & Joint Surg.*, 13: 91-104, 1931.
- HIBBS, R. A. et al. An operation for stiffening the knee joint. *Ann. Surg.*, 53: 406, 1911.
- HENDERSON, M. S. Nonunion in fractures: the massive bone graft. *J. A. M. A.*, 81: 463, 1923.
- HOKE, M. An operation for stabilizing paralytic feet. *A. J. Ortho. Surg.*, 10: 494, 1921.
- INCLAN, ALBERTO. Arthrosis posterior y anterior del Tobillo, 1939. Original report read before the Third International Congress of Orthopedia, Rome, Italy, September, 1936.
- JOHNSON, R. W. A physiological study of the blood supply of the diaphysis. *J. Bone & Joint Surg.*, 9: 153, 1927.
- JOYCE. A new operation for substitution of thumb. *Brit. J. Surg.*, 5: 499, 1918.
- LEXER, E. Ueber Gelenktransportation. *Med. Klin.*, 4: 817, 1908.
- LYLE, H. H. The formation of a new thumb by Klapp's method. *Ann. Surg.*, 59: 767, 1914.
- L'EPISCOPO, J. B. Bone block for painful hips. *J. Bone & Joint Surg.*, 4: 903, 1938.
- MAYER, LEO. An operation for the cure of paralytic genu recurvatum. *J. Bone & Joint Surg.*, 12: 845, 1940.
- NICOLADONI, K. Ueber Schnentransplantationen. *Versamml. Deutsche Naturforsch. u. Aerzte im Salzberg*, 1880, 54.
- OLLIER, L. Traité experimental et clinique de la régénération des os et de la production artificielle du tissu osseux. 2 vols., Paris, 1867.
- PHEMISTER, D. B. Operative arrestment of longitudinal growth of bones in the treatment of deformities. *J. Bone & Joint Surg.*, 15: 1, 1933.
- SPEED, KELLOGG. Nonunion after fracture. *Ann. Surg.*, vol. 90, 1929.
- SOULE. Soule's operation: arthrodesis of some of the smaller joints in the treatment of paralytic and acquired deformities. *J. A. M. A.*, 58: 19, 1912.
- STEINDLER, A. Reconstructive Surgery of the Upper Extremity. P. 39, New York, 1923. D. Appleton Century Co.
- VACCHELLI, S. L'arthrodesi scapoloomerale. *Chir. d. org. di movimento*, 4: 253, 1920.
- VULPIUS, O. Arthrodese des Schultergelenkes. *Ztschr. f., ortbop. Chir.*, vol. 19, 1908.
- WOLFF, JULIUS. Ueber Knochenwachstum. *Klin. Webschr.*, 76: 110, 1868.
- WATSON-JONES, R. The repair of skull defects by a new pedicle bone graft operation. *Brit. M. J.*, May 6, 1933.



## AUTHOR INDEX TO VOLUME LXIII

- Albee, Fred H., 421  
 Altenberg, Alfons, 337  
 Andrews, Sherman E., 259
- Baker, Edgar C., 105  
 Bates, William, 377  
 Behrend, Moses, 90  
 Bergmann, Ernst, 218  
 Bernstein, Phineas, 261  
 Berson, Morton I., 148  
 Best, R. Russell, 181  
 Bilderback, J. B., 411  
 Blatteis, Simon R., 415  
 Bolen, H. Leonard, 316  
 Brock, Clayton E., 371  
 Brodie, Nathan N., 394  
 Brown, Merle J., 276  
 Brown, Walter E., Jr., 276  
 Brunkow, Ben H., 86  
 Burden, Verne G., 61  
 Busch, Irving, 47
- Camp, Milton N., 259
- de Amesti, Felix, 78  
 Denoon, Harry L., Jr., 257  
 Dibbins, Samuel A., 402  
 Dockerty, Malcom B., 173  
 Doran, William T., 146  
 Doran, William T., Jr., 146  
 Drayton, William, Jr., 377  
 Drexel, A. E., 150  
 Drosin, Louis, 344  
 Dunn, James, 246
- Erich, John B., 153
- Ficarra, Bernard J., 282, 394  
 Finley, Robert Kent, 337
- Gale, Conrad K., 368  
 Gendel, Sam, 28  
 Gibbs, Edward W., 405
- Goehring, Walter G., 278  
 Goehring, W. Orr, 278  
 Gorrell, Ralph L., 102  
 Gray, Howard K., 173  
 Greenfield, Elena, 324  
 Grego, J. Gregory, 398  
 Griesemer, Wellington D., 16  
 Grindlay, John H., 280  
 Gurdjian, E. S., 236  
 Gutierrez, Robert, 301
- Haas, S. L., 253  
 Haberer, J. J., 28  
 Harkins, Henry N., 141, 398  
 Held, I. W., 47  
 Henderson, W. Carey, 257  
 Hess, Elmer, 388  
 Hipsley, Roland W., 357  
 Holman, Emile, 96  
 Horowitz, Irving, 272  
 Howser, John W., 118, 187  
 Hutner, Sydney, 124
- Iason, Alfred H., 69
- Jacobs, Maurice B., 382  
 Johnston, Herbert A., 329  
 Joldersma, R. D., 352  
 Judovich, Bernard, 246, 377
- Kaminester, Sanford, 136  
 Koerber, Kenneth A., 192  
 Kramer, G. B., 240
- Lichtenstein, Manuel E., 382  
 Loomis, Lyon K., 56  
 Lubin, Samuel, 272
- MacMahon, H. Edward, 107  
 Macpherson, F. L., 352  
 Maltz, Maxwell, 203  
 Marshall, Wallace, 324  
 Martin, S. J., 249
- May, Hans, 34  
 Meredith, J. M., 10  
 Miscall, Laurence, 249  
 Mitchell, Robert McN., 136  
 Myers, William H., 362
- New, Gordon B., 153  
 Norton, Walter A., 408
- O'Donoghue, John B., 382
- Phaneuf, Louis E., 107  
 Phillips, John Roberts, 267
- River, Louis P., 118  
 Rominger, Ruth F., 362  
 Rosenblatt, Millard S., 411  
 Ross, Donald E., 3  
 Rovenstine, E. A., 249
- Sanborn, Earl, 131  
 Sedwitz, Samuel H., 105, 240  
 Shaffer, James Milo, 337  
 Smith, Robert S., 206  
 Strain, Richard E., 1  
 Strange, Theodore B., 144  
 Sutton, Paul W., 405  
 Swenson, S. A., Jr., 141
- Thiessen, Norman W., 214
- Vadheim, James L., 173  
 Vaughn, Arkel M., 118  
 Vickers, Denver M., 168
- Watter, Leonid, 348  
 Webster, J. E., 236  
 Weiner, David O., 418  
 Welt, Bernard, 415  
 Whitcomb, C. A., 304  
 White, A. S., 28  
 White, J. William, 124, 151  
 Word, Buford, 371

# SUBJECT INDEX TO VOLUME LXIII

(Bo. B.) = Bookshelf Browsing; (E.) = Editorial

## A abdomen

- incisions of, and inguinal hernia, 214
- pioneers in surgery of (Bo. B.), 282
- pregnancy in, 402
- Abdominal pregnancy, 107
- Abscess
  - of brain, 10
  - pyogenic, of liver, 206
- Absence of half of diaphragm, 411
- Adenocarcinoma, primary, of jejunum, 382
- Administration of fluid beneath fascia lata, 337
- After-treatment of dislocation of elbow, 56
- Aged, pyogenic liver abscess in, 206
- Aid in treatment of varicose veins, 105
- Air, compressed, and rupture of rectosigmoid, 141
- American pioneers in abdominal surgery (Bo. B.), 282
- Anatomy of pelvic tissue spaces, 86
- Anesthesia, spinal, and severely wounded, 348
- Apparatus for care of ileostomy, 280
- Appendectomy, pain after, 246
- Appendicitis, 90
- Appendix, mucocoele of, 362
- Application of sulfonamides in wounds, 96
- Army personnel, varicose veins in, 28
- Astragalus, fracture of, 418

## B bank, fluid, ascitic (E.), 1

- Bladder, urinary, herniation of, 69
- Blood studies, value of, in malignancy, 316
- Bone
  - graft surgery (Bo. B.), 421
    - to mandible, 153
    - necrosis of, in hip lesions, 218
    - plate, T and G, 352
- Book Reviews:
  - A Surgeon's World, 299
  - Diseases of the Breast, 297
  - Essentials of Gynecology, 300
  - Genealogy of Gynaecology, 299
  - Gynecology with a Section on Female Urology, 300
  - Modern Management of Colitis, 298
  - Pain, 298
  - Principles and Practice of Obstetrics, 298
  - Surgical Errors and Safeguards, 299
- Brachialis muscle and myositis ossificans, 56
- Brain, abscess of, 10
- Brucellosis and orchitis, 131
- Burns, treatment of, 34, 324

## C cancer of lip, 304

- Carcinoma of gallbladder, 173

- Care of ileostomy, apparatus for, 280
- Ceepry'n, 240
- Cesarean section, 168
- Childbirth, hematomas following, 272
- Closure of loop colostomy, 187
- Colon, distal, and distal ileum, 118
- Colostomy, loop, closure of, 187
- Combination of nail and screw for fixation of fractures of femur, 329
- Complication of brucellosis, orchitis as, 131
- Concept, etiological, of pancreatitis, 394
- Continence, urinary, after pelvic surgery, 261
- Control of hemorrhage in inversion of uterus, 408
- Cotton suture material, 371
- Cyst, pilonidal (E.), 151

## D iaphragm, absence of half of, 411

- Dislocation
  - of hip, 16
  - posterior, of elbow, 56
  - subastragaloïd, 276
- Diverticulum, esophageal, 3
- Duct, biliary, fistula of, 181
- Duodenum, ulcer of, 61

- E ffects, cardiovascular and respiratory, from ganglia stimulation, 249
- Elbow, dislocation of, 56
- Esophagus
  - diverticulum of, 3
  - varices of, 415
- Evolution of bone graft surgery (Bo. B.). 421

## F ascia lata, fluid administration beneath, 337

- Femur, fractures of neck of, 329
- Fever, undulant, and orchitis, 131
- Fistula, biliary, 181
- Fixation
  - internal, in fracture of astragalus, 418
  - of fractures with nail and screw, 329
- Fluid
  - administration beneath fascia lata, 337
  - bank, ascitic (E.), 1
- Fracture
  - of astragalus, 418
  - of lesser tuberosity of humerus, 253
- Fracture of tibia and fibula, 352
  - of neck of femur, 329

## G allbladder

- carcinoma of, 173
- polyposis of, 398

Ganglia, celiac, stimulation in man, 249  
 Gauze pressure treatment for burns, 324  
 Gestation of eight months and ectopic pregnancy, 257  
 Gown, thumb, for surgeon, 150  
 Grafts, bone, to mandible, 153

## H

Hematoma  
 ossified, of subscapula, 124  
 postpartum, 272  
 Hemorrhage control in inversion of uterus, 408  
 Hernia  
 inguinal, after abdominal incisions, 214  
 traumatic, diaphragmatic, 267  
 Hernias, 259  
 Herniation of urinary bladder, 69  
 Hip  
 dislocations of, 16  
 lesions of, and bone necrosis, 218  
 Humerus, fracture of tuberosity of, 253

## I

Ileum  
 distal, and distal colon, 118  
 terminal, thrombosis of, 146  
 Incisions, abdominal, and inguinal hernia, 214  
 Industrial surgery in shipbuilding industry, 192  
 Infection, skin as source of, 47  
 Inguinal hernia after abdominal incisions, 214  
 Injections, procaine, for skeletal pain, 102  
 Injury  
 ski, 276  
 to head, and sedation, 236  
 Intussusception and adenocarcinoma, 382  
 Invagination for esophageal diverticulum, 3  
 Inversion of uterus, 408  
 Involvement of distal ileum and distal colon, 118

## J

Jejunum, adenocarcinoma of, 382  
 Kidneys  
 stones in, 388  
 tuberculosis of (E.), 301

## L

Lesions of hip, and bone necrosis, 218  
 Lip, cancer of, 304  
 Lithiasis, renal, bilateral, 388  
 Liver, abscess of, in aged, 206  
 Loop colostomy, closure of, 187

## M

Malignancy, value of blood studies in, 316  
 Man, celiac ganglia stimulation in, 249  
 Management  
 of biliary fistula, 181

Management, of brain abscess, 10  
 of regional ileitis, 118  
 of varicose veins, 28  
 Mandible, bone grafts to, 153  
 Material, cotton suture, 371  
 Mucocele, retroperitoneal, of appendix, 362  
 Muscle, brachialis, and myositis ossificans, 56  
 Myositis ossificans, 56

## N

Nail and screw for fixation for fractures, 329  
 Neck of femur, fracture of, 329  
 Necrosis of bone in hip lesions, 218  
 Nose, reconstruction of tip of, 203

## O

Operation  
 cesarean, rational use of, 168  
 for pilonidal sinuses, 357  
 invagination, 3  
 Orchitis and brucellosis, 131  
 Osteochondritis dissecans, 144  
 Osteotomy, lateral, 368

## P

Pain  
 after appendectomy, 246  
 in shoulder and upper extremity, 377  
 treatment of, 102  
 Pancreatitis, hemorrhagic, 394  
 Patients with head injury, 236  
 Pelvis, surgery of, and urinary continence, 261  
 Penicillin, 136  
 Perineorrhaphy postpartum versus perineal repair, 344  
 Persistence of pain after appendectomy, 246  
 Personnel, army, varicose veins in, 28  
 Pin, metal, in fixation of fractured astragalus, 418  
 Pioneers, American, in abdominal surgery (Bo. B.), 282  
 Polypsis of gallbladder, 398  
 Pregnancy  
 abdominal, 107, 402  
 ectopic, 257  
 Pressure, gauze, in treatment of burns, 324  
 Procaine injections for skeletal pain, 102

## R

Recognition of brain abscess, 10  
 Reconstruction of nasal tip, 203  
 Rectosigmoid, rupture of, 141  
 Reduction of dislocation of elbow, 56  
 Regional ileitis, 118  
 Rehabilitation in shipbuilding industry, 192  
 Repair  
 of urinary bladder herniation, 69  
 perineal, versus perineorrhaphy, 344  
 Rhinometer, new, 148  
 Roentgenology and polypsis of gallbladder, 398  
 Rôle of bone necrosis in hip lesions, 218  
 Rupture of rectosigmoid by compressed air, 141

**S**calenus anticus syndrome and pain in shoulder, 377  
 Section, cesarean, 168  
 Sedation in head injury, 236  
 Sepsis, puerperal, and penicillin, 136  
 Septicemia, hemolytic streptococcus, 136  
 Shipbuilding industry, rehabilitation in, 192  
 Shoulder, pain in, 377  
 Sinuses, pilonidal, operation for, 357  
 Ski injury, 276  
 Skin as source of systemic infection, 47  
 Source of infection, skin as, 47  
 Spaces, pelvic tissue, 86  
 Spinal anesthesia and severely wounded, 348  
 Stimulation, ganglia, in man, 249  
 Stomach, tumors of, 78  
 Stones in kidney, 388  
 Studies, clinical and bacteriological, of cephryne, 240  
 Study  
     of cancer of lip, 304  
     of carcinoma of gallbladder, 173  
 Subscapula, hematoma of, 124  
 Sulphonamides in wounds, 96  
 Support, overhead, for postoperative use, 278  
 Surgeon, thumb gown for, 150  
 Surgery  
     abdominal, pioneers in (Bo. B.), 282  
     bone graft (Bo. B.), 421  
     industrial, 192  
     of renal tuberculosis (E.), 301  
     pelvic, and urinary continence, 261  
     plastic, of nasal tip, 203  
 Suture, cotton, 371

**T** and G bone plate, 352

Technic  
     for closure of loop colostomy, 187

Technic, new, for reconstruction of nasal tip, 203  
 Teratoma, congenital, of thyroid, 405  
 Thrombosis, mesenteric, of terminal ileum, 146  
 Thyroid, teratoma of, 405  
 Tibia and fibula, fracture of, 352  
 Tip, nasal, reconstruction of, 203  
 Tissue spaces, submuscle, pelvic, 86  
 Tract, gastrointestinal, malignancy of, 316  
 Trauma  
     diaphragmatic hernia and, 267  
     dislocations of hip caused by, 16  
 Treatment  
     of burns, 34  
     gauze pressure in, 324  
     of fracture of astragalus, 418  
     of skeletal pain, 102  
     of varicose veins and venography, 105  
 Tuberculosis, renal, surgical (E.), 301  
 Tuberosity of humerus, fracture of, 253  
 Tumors, malignant, of stomach, 78

**U**lcer, duodenal, 61

Uterus, inversion of, 408

**V**alue of blood studies in malignancy, 316

Varices, esophageal, 415  
 Veins  
     varicose, 28  
     and venography, 105  
 Venography in treatment of varicose veins, 105

**W**ounded, severely, and spinal anesthesia, 348

Wounds, fresh and contaminated, 96

